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WERNHER VON BRAUN:
Putting a Spacecraft
"in the Groove"

Popular Science

Monthly

**If Your Car Goes
in the Water**

Findings by Michigan
State Police and
Indiana University
That May Save
Your Life



**New Stereo
Tape
Changer**



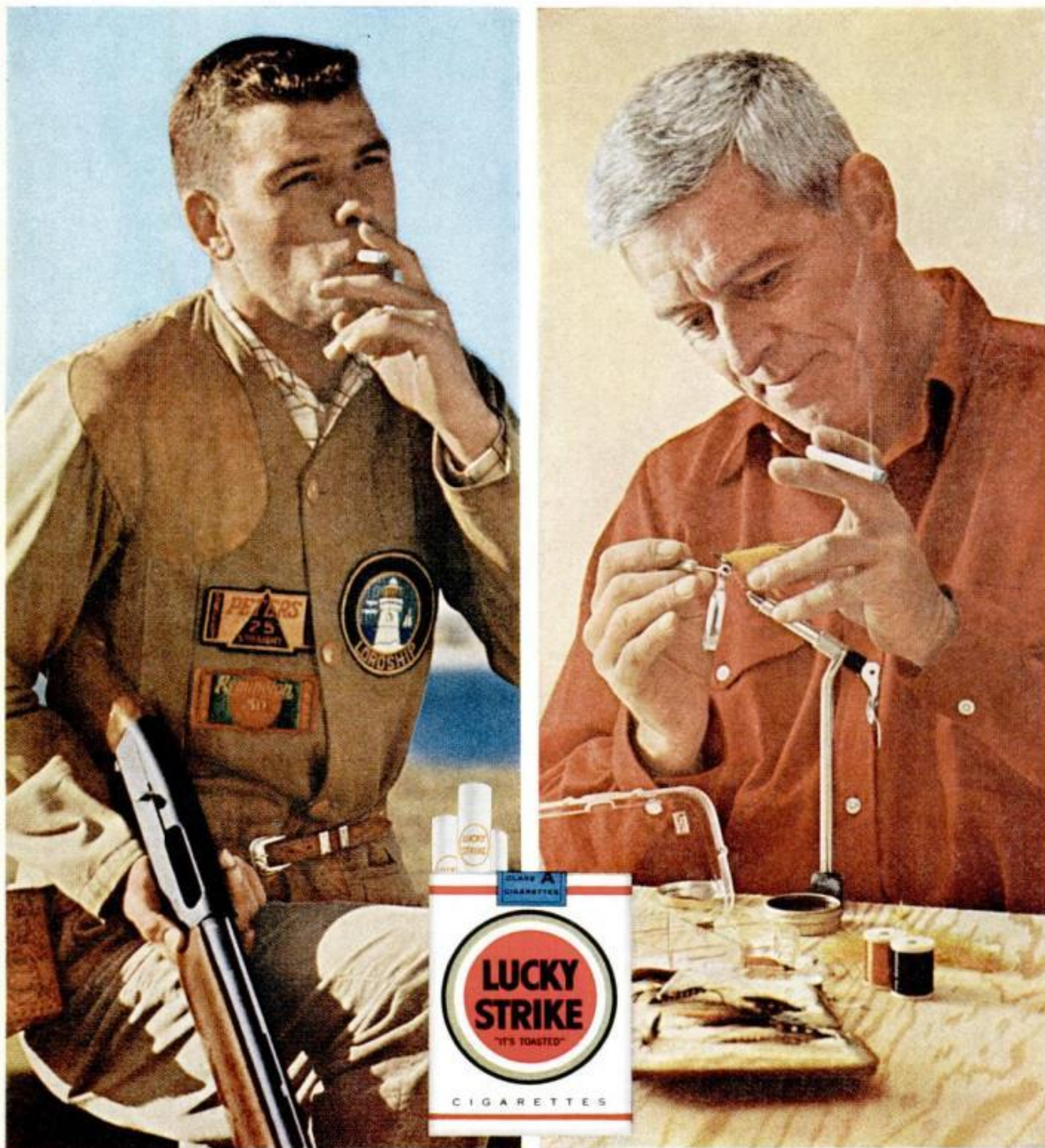
**Test-Driving
the 1896 Ford**

**World's Hottest
Handgun**

**Beefed-Up Cars—
Built for Towing**

Get Lucky

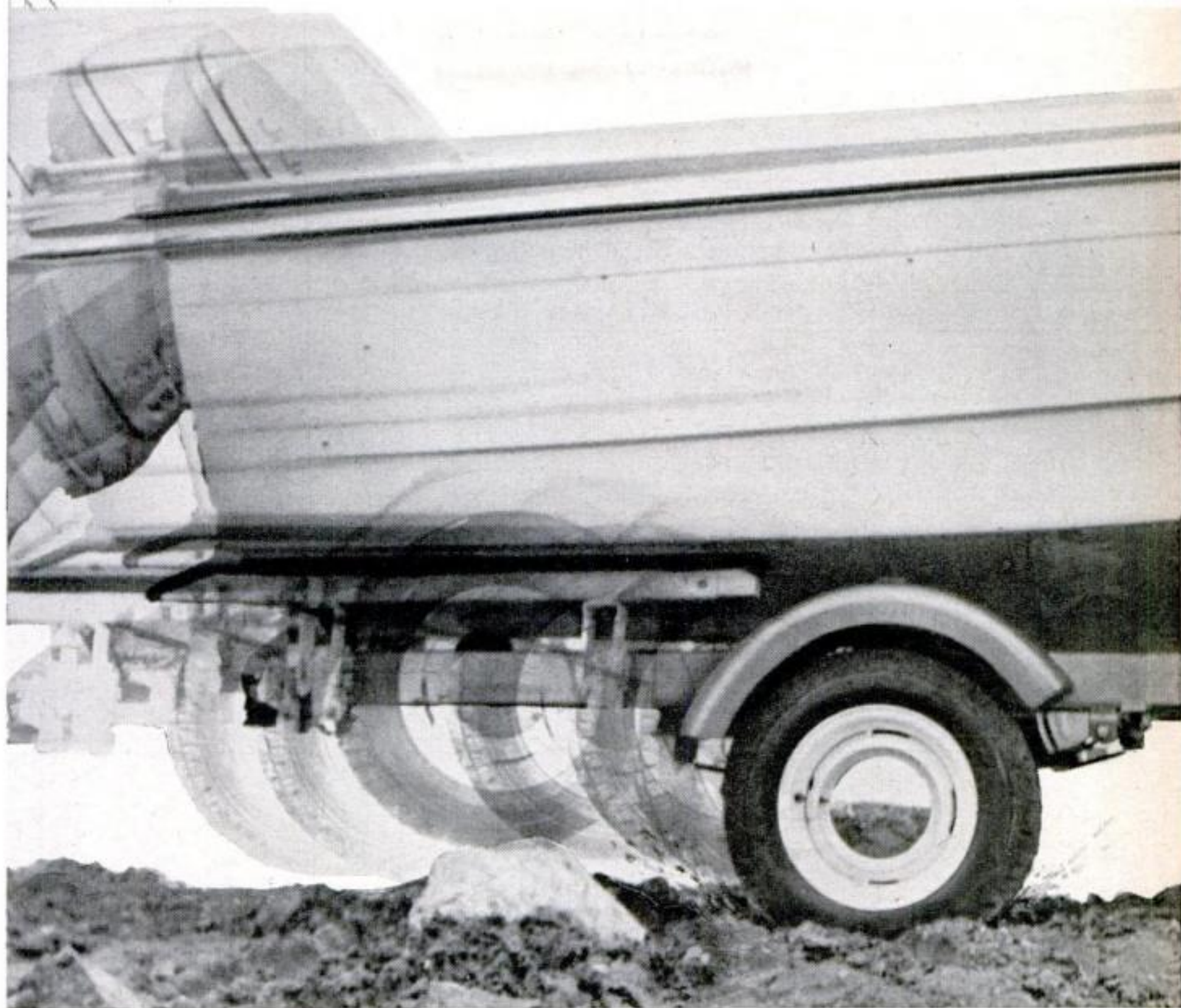
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So protect *your* boating fun with 3-T *Nylon* Super Rib trailer tires. That way you won't be dropping anchor—along the road. Goodyear, Akron 16, Ohio.

ANOTHER REASON WHY: MORE TONS ARE HAULED ON GOODYEAR TRUCK TIRES THAN ON ANY OTHER KIND

GOODYEAR

Next Month in Popular Science

- **What's Coming in the '64 Cars?** Here's the inside dope on engines, styling, and prices—in a PS preview of the cars you'll see next fall.
- **Cooling Your House with Free Air.** Let nature do the work! Air currents can lower your house temperature by as much as 8 to 12 degrees.
- **Living Beneath the Sea.** PS exclusive: How divers are risking death to plant a base camp 100 fathoms down on the continental shelf.
- **Build Your Own Transistor Tachometer.** Easy-to-follow instructions for making a combination tach, dwell meter, and circuit-continuity tester.

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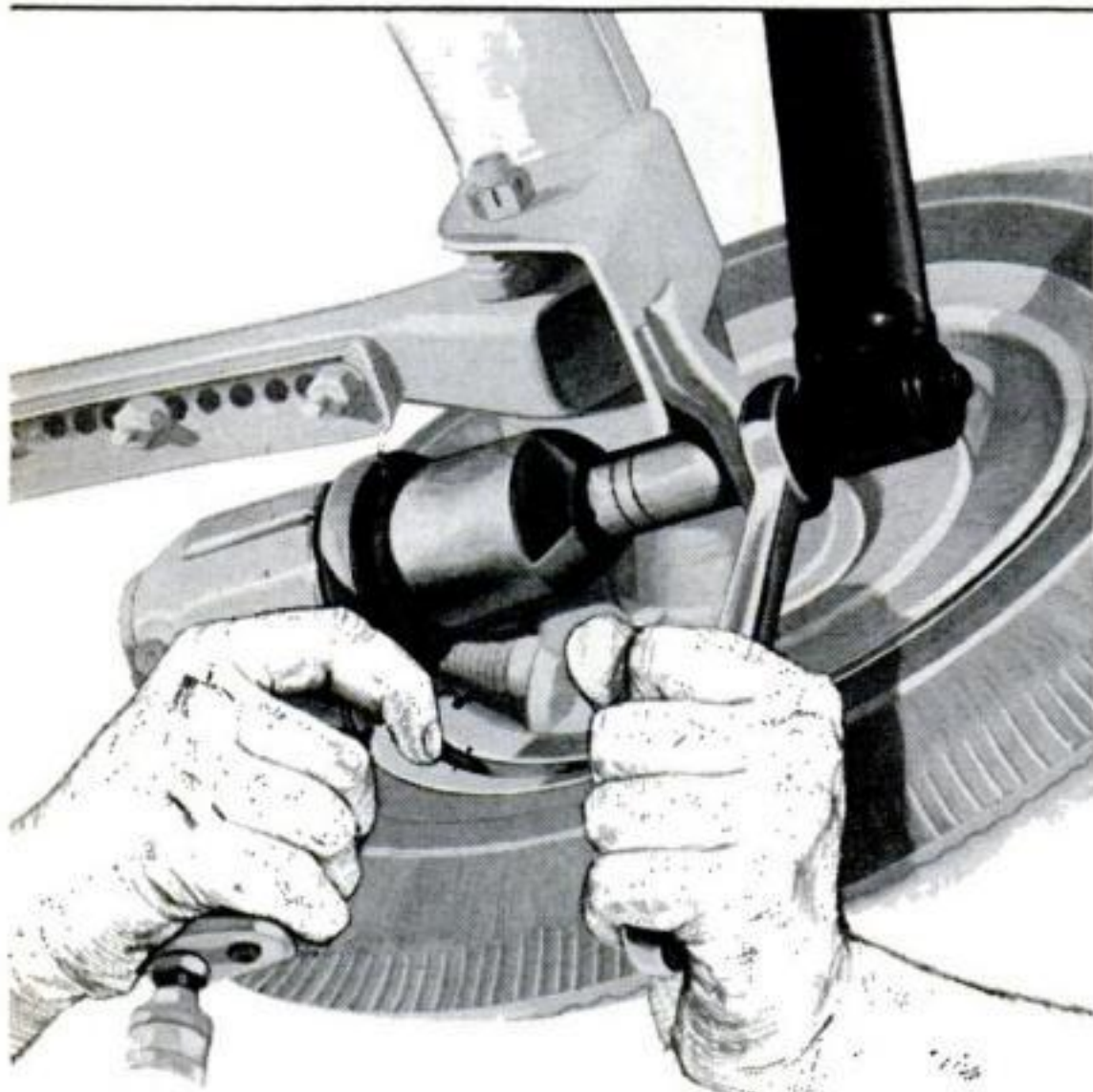
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- ☐ Salesmanship
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- ☐ Nuclear Energy
- ☐ Plastics
- ☐ Pulp, Paper

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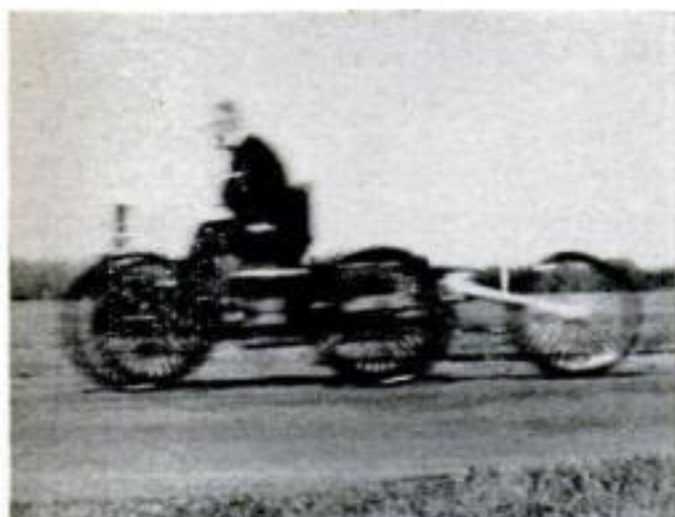
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June 1963



Devon Francis test-drives
Henry Ford's first car. What's
it like? Visibility: Great.
Max speed: 18 m.p.h. Page 35



Bolt-action handgun
slams 'em out like a
rifle—at a hot 2,650
ft./sec. Page 138.



The Do-X was a dud, but behind
her came a stream of mighty
flying boats that—briefly—ruled
the ocean air lanes. Double-
length feature. Page 71.

CARS AND DRIVING

- [PS Tests the 1896 Ford • 35](#)
- [Re-Creating the Three-Hoss Shay • 37](#)
- [If Your Car Goes in the Water • 45](#)
- [Which Chevy Did 164 m.p.h.? • 56](#)
- [Skylark: Buick's Sporty Special • 80](#)
- [Cars to Order for Trailer Towing • 98](#)

SCIENCE AND INVENTIONS

- [Inside the First Pushbutton Prison • 51](#)
- [Porpoises . . . Smarter Than People? • 59](#)
- [He's Got the World in His Hands • 82](#)
- [Para-Kiting—New Skyriding Sport • 86](#)
- [Space Age Comes to the Playground • 88](#)

SPACE AND AVIATION

- [Wernher von Braun: Guiding Spacecraft • 14](#)
- [1,000 Days in Frozen 'Space' • 42](#)
- [Spacecraft Launch Pad Floats to Site • 49](#)
- [Ranger 6, Where Are You? • 64](#)
- [When Boats Had Wings • 71](#)

BOATS AND BOATING

- [Air Boat Speeds Over Water or Snow • 50](#)
- [Boat Boom Puts Small Fry on Skis • 115](#)
- [Jim Roe Tests All the MerCruisers • 116](#)
- [Now—a Jet Drive for Your Outboard • 122](#)



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Every year we have a passionate love affair with our cars. You'd think it would cool off a bit after we build a few thousand of them. But all it takes to start us twitching all over again is for one of our 326HO* Tempests to go growling by in its businesslike way.

326HO? That's our three-tiger V-8, a no-nonsense piece of sporting goods with an input via four yawning throats, an outgo via two thrumming pipes, and an outcome that's more than a little startling.

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gallop, we suggest you gird yourself with some of our super-handling stuff*. Like heavy-duty springs and shocks, plus an extra-fast steering ratio of 20 to 1, for instance.

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That way we can keep our love affairs straight.

Wide-Track Pontiac Tempest

HOME AND SHOP

- [Let It Fall! Let It Fall! • 97](#)
- [A Travel Console for Your Car • 101](#)
- [Pry Bars Lift 5 Tons or Pull a Nail • 102](#)
- [Good Ideas All Over the Lot • 105](#)
- [Poison Bugs—NOT Yourself • 106](#)
- [Build a Battery-Powered Mower • 110](#)
- [Add a Sundeck to Your Home • 113](#)
- [Stemming the Tide with Turf • 114](#)
- [Anchors for Radial-Saw Work • 132](#)
- [What's New in Tools • 137](#)
- [Coating Waterproofs Shower Walls • 138](#)

ELECTRONICS

- [Tape Changer: It's Here at Last • 91](#)

GUNS AND SHOOTING

- [2-Eyed Target Sharpens Your Aim • 96](#)
- [World's Hottest Handgun • 138](#)

PHOTOGRAPHY

- [Photographically Speaking • 125](#)
- [New at the Camera Shows • 126](#)

AUTO REPAIRS

- [Hints from the Model Garage • 140](#)
- [Gus Tracks Down a Foreign Agent • 144](#)

PICTURE NEWS

- [Fog Chamber Tests Landing Lights • 50](#)
- [Escape Capsule for Supersonic Jets • 56](#)
- [Japanese Express Hits 151 M.P.H. • 58](#)
- [Lighthouse with 28-Million Candles • 90](#)

SHORT CUTS AND TIPS

- [Portable Rod-Rack for Boaters • 150](#)
- [Adjustable Supports for Shelves • 150](#)
- [One Way to Stretch a Bolt • 152](#)
- [Controlling Saw-Cut Depth • 152](#)

EVERY MONTH

- [PS Readers Talk Back • 6](#)
- [Science Newsfront • 23](#)
- [Getting Ahead • 28](#)
- [Detroit Report • 32](#)
- [New Ideas from the Inventors • 69](#)
- [I'd Like to See Them Make • 85](#)
- [Shop Talk • 95](#)

PS readers talk back

Diving in the Mississippi Mud

"Time Bombs in the Mississippi" [Apr.] was very interesting except for the outdated diving outfits that were employed. Had an outfit with scuba and "hookah" attachments been used I believe many troubles would have been overcome, particularly the time factor. A diver using newer equipment can worry about the job at hand, and not the haul lines.

AL TEEPLE, Chicago.

... The "time bomb" story was the finest and most exciting I have ever read. Without it, I would never have known the real story of the work and bravery involved in removing the deadly chlorine tanks from the depths of the river. I think it was a wonderful tribute to



everyone who participated in this historic feat, from the Emergency Planning office in Washington to the divers and the local citizens of the area concerned.

This story intrigued me so much that I think a movie or a TV show should be made of it. What more exciting and courageous true story of Americans in action during a disaster could be presented to the public?

MRS. DWAIN CRAWFORD, Benton, Ark.

The Car Doctors

"Here Come the Car Clinics" [Mar.] was the nicest reading I have seen for a long time. The Repair Center sounds like a wonderful idea, and good for everyone. Even garages and service departments can use the diagnosis to handle their jobs better. To me, the amazing thing is that neither the automotive industry nor the oil companies have made more headway in providing efficient car care before now.

JOHN B. MAYO, Raleigh, N.C.

... We manufacture a dynamometer for car testing which, unlike the one at the Mobil Center, has infinitely variable speed and load ranges. This means that a motorist who complains about lack of power, acceleration, or fuel

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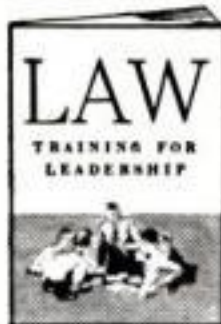
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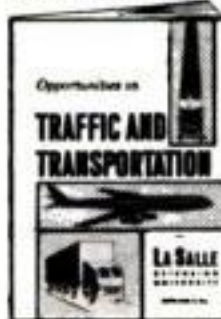
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economy at turnpike speeds can have his car checked at exactly those simulated speeds, and not at arbitrarily preset speeds.

BERT WALKER

Clayton Mfg Co., El Monte, Calif.

... I went to the Mobil Repair Center and greatly appreciated dealing with people who acted and behaved like mature men. Too often when going to the dealer or local garage, odd theories are what you get when questioning the faults of your car.

It was ironic that on the first trip the diagnosis revealed a faulty point setting: The points had been installed in one of their own gas stations for \$4.25. The charge for resetting was another \$1.50.

The Repair Center proved one thing: Too much time and money is lost because repairs are not done right the first time.

WILLIAM MUNCHMEYER, Danbury, Conn.

The Wages of Progress

Every time the telephone company talks of progress, I think back to an invention they had when I was a kid. It was called an "operator."

No dialing was required—the invention acted on voice command. You would say, for example, "I want Esplanade 4567," and seconds later you had your party. Sometimes you only had to say, "Give me the Grace Theater," or

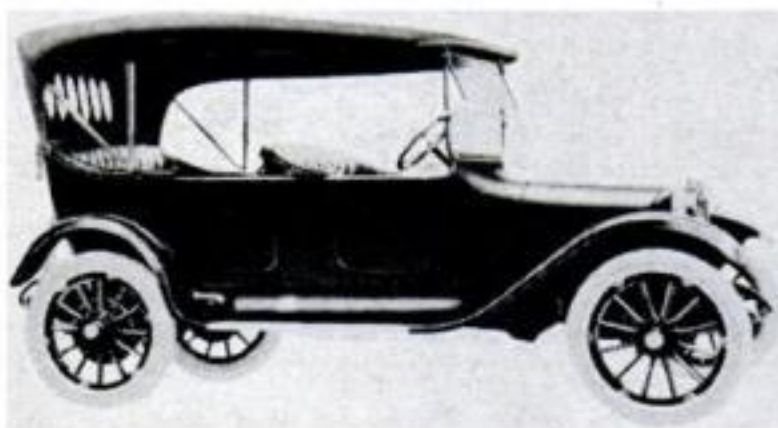
even, "Would you please tell Doris to get off the line because I have to talk to Eddie."

I don't want to have to remember 10-digit numbers. Tell 'em to bring back that old invention.

BUD HOWARD, Brooklyn, N.Y.

Search for an Antique Car

Dodge's 50th anniversary occurs in 1964. We wonder if you happen to know of anyone



who has a 1914 Dodge who would be willing to sell or rent it to us for display, exhibit, and other promotional activities.

F. W. WYLIE, Dodge Division, Detroit.

Records and the Law

Having a little experience with offbeat sounds, we were most interested in "This Is

CONTINUED

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Johnson REELS/RODS

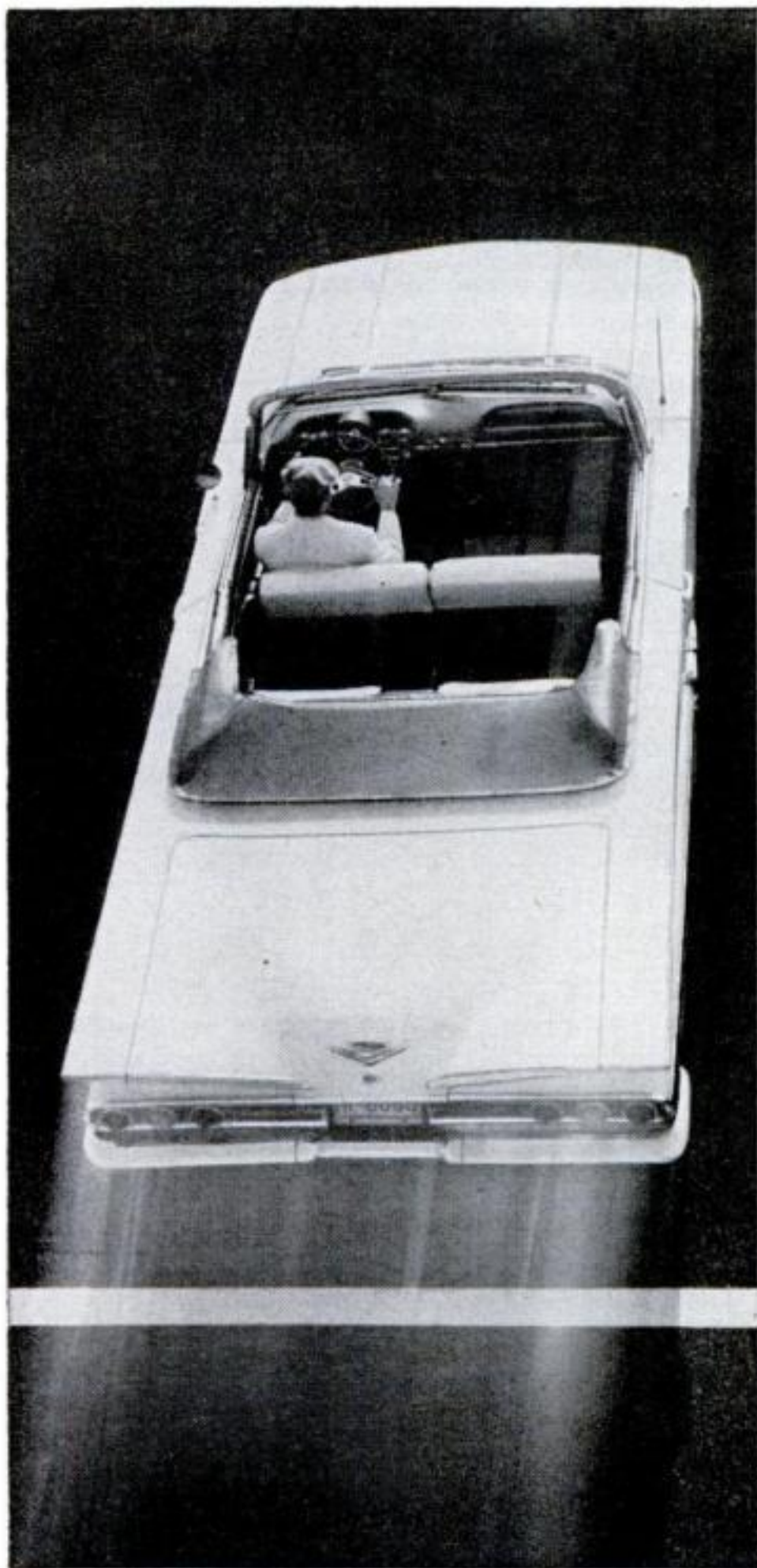
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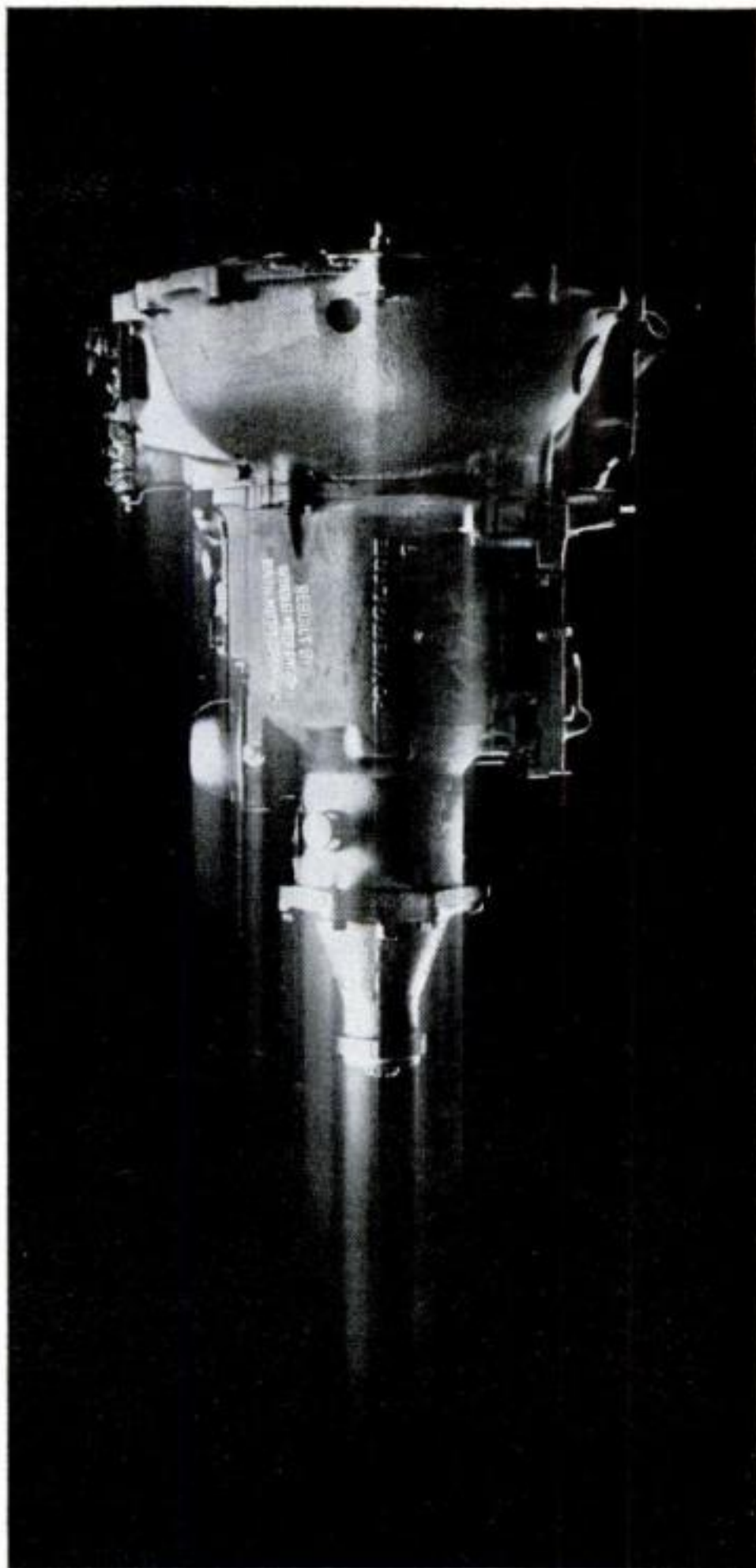
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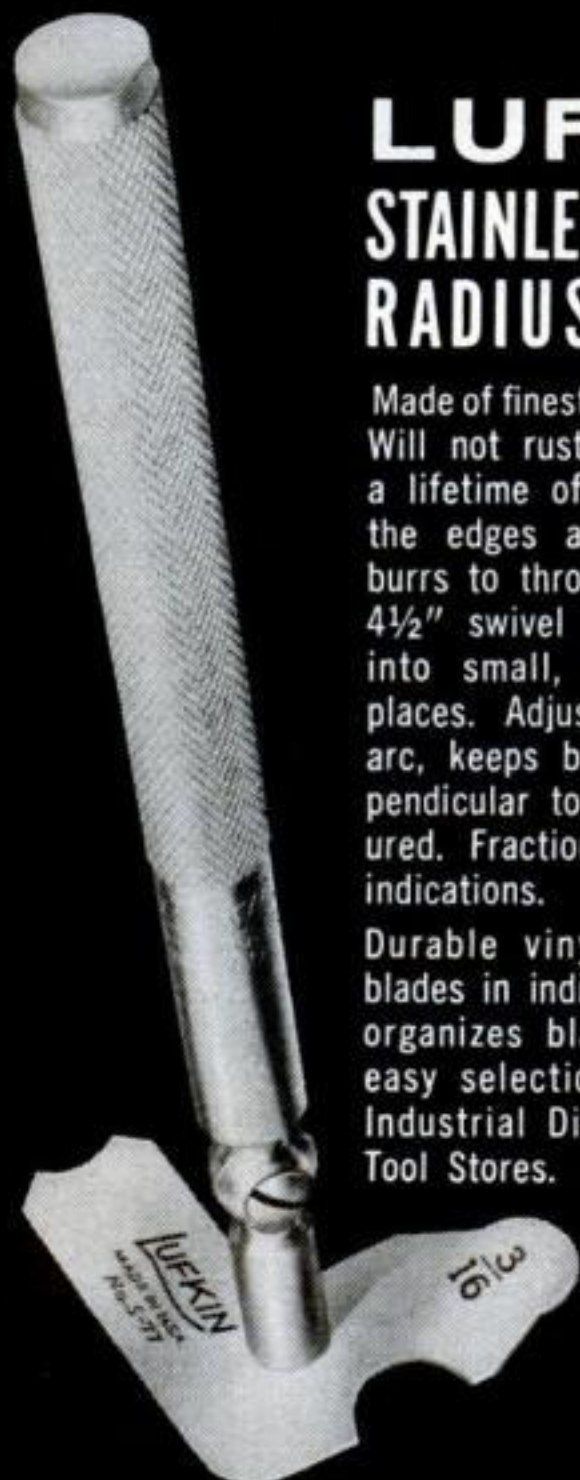


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- 2 OUTSIDE CORNER
- 3 INSIDE ROUND
- 4 OUTSIDE ROUND
- 5 CONVEX SURFACE



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SAGINAW, MICHIGAN

Hi-Fi?" [Mar.]. We would like to clear up a minor point. The "Call of the Wild" is banned by federal law only for use against ducks and geese, a ruling in which we are in complete agreement. It may be used for all other types of hunting.

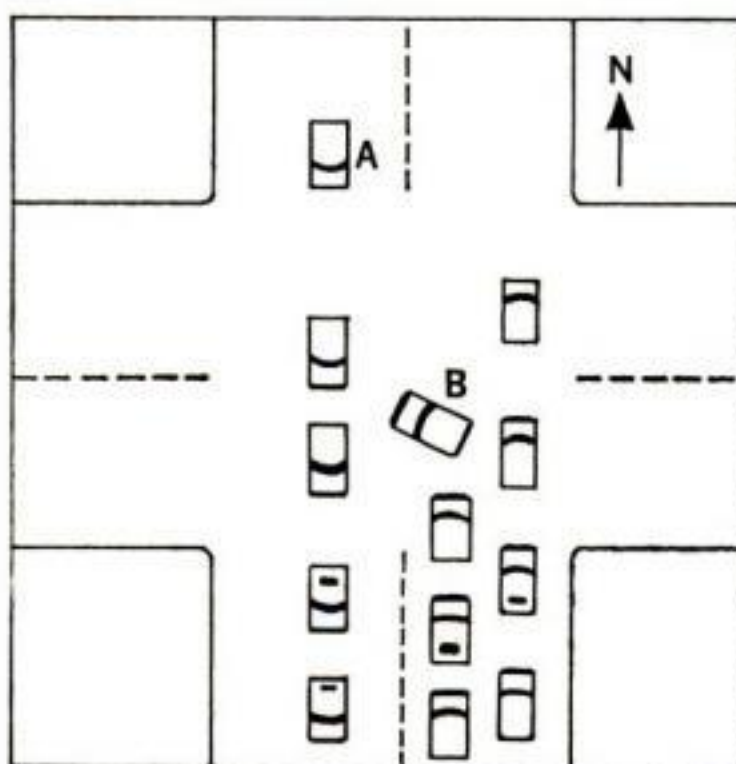
J. ELLIS ORR,

Wightman Electronics, Inc., Easton, Md.

Wightman Electronics makes varmint-decoy records.

Unplugging the Bottleneck

It seems to me there are several things wrong, and hazardous, with one problem in "Slow Drivers Can Kill You," [Apr.]. The car



Southbound car A should stop short of intersection and let B turn left

immediately behind A may not expect you to stop with a green light in view. A right-hand or curb-lane car going southbound might collide with the northbound car completing his left-hand turn. California traffic law does not permit a driver to appoint himself a traffic controller.

LEE ZOELLER, Lakewood, Calif.

The sketch shows this to be a busy intersection, probably with a traffic light, so approaching cars should be traveling toward it at moderate speed, expecting turn-offs and light changes. No curbside car is shown. Still, if car A stops and B proceeds, protected by A, car B's driver can look the situation over before proceeding. A curbside car, then, would be in the same situation as car A.

... It is incomprehensible to me how Dr. Malfetti can justify his argument when all the evidence points in the opposite direction.

Twelve fatalities were reported in Colorado in the eight days from March 26 onward. Eight resulted from cars out of control. The others, from the same cause, were specifically due to missing a curve, skidding (227 feet),

CONTINUED

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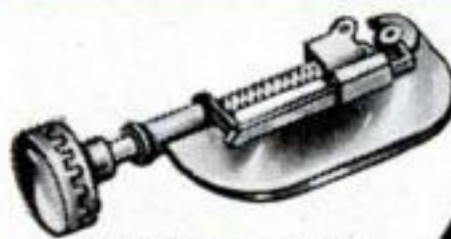
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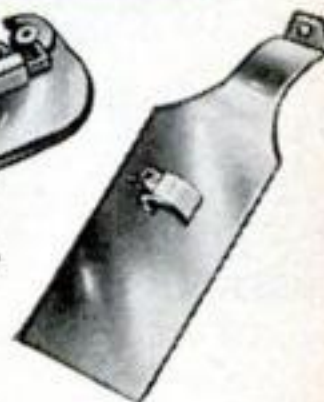
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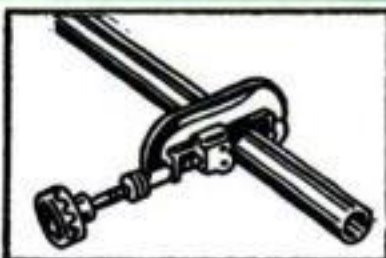
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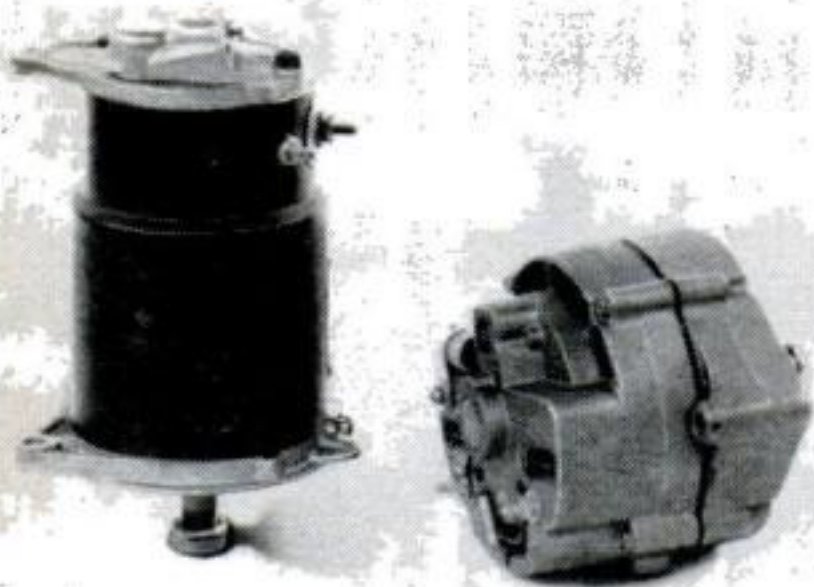
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*Do you recognize these two pieces of equipment?
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What does this symbol stand for?

An alternator (top right) is now found on many new cars, replacing the old-time standard generator (left). The life preserver is the symbol of Quaker State Motor Oil—the best engine life preserver. Made from 100% pure Pennsylvania Grade Crude Oil, Quaker State gives every car longer-lasting lubrication, top protection. Insist on Quaker State—your best engine life preserver.



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rolling down an embankment, being crushed between parked cars. The last was caused by an 18-year-old girl who bounced into three parked cars.

These were the only fatalities reported during the period. All were due to excessive speed, none due to slow drivers or older drivers.

FRANK S. MORRISON, Denver.

Big Brother Watches Pennies, Too

"Big Brother 7074" is quite an expensive gadget ["Big Brother 7074 Is Watching You," Mar.]. But look at how much our government saves us each year by renting it at \$4,000 per day: It would cost \$1,200,000 to buy it, but renting per day costs \$1,460,000 each year! Is this how the Internal Revenue Department saves the taxpayers money?

T. P. PHILLIPS, Belleville, Mich.

By renting, the U.S. saves money. Included in the rental price is staffing and maintenance—two whopping items. Most large industrial firms also rent their big computers.

A Special for Pole Carvers

Last spring [May], I read your piece on carving a totem pole. I have now carved a 20-foot telephone pole and I have a few suggestions for anyone interested in this art:

1. Capping the top of the pole with galvanized-iron sheet will keep it from cracking from weathering. Cut a circle two inches larger than the diameter of the pole and hammer down the sides.

2. When using a pole of 12- to 14-inch diameter, carve both sides of the pole. I did this and it is extremely effective.

3. Leave three or more feet at the base of the pole uncarved for coating with a saturant to keep it from rotting.

JEFFREY W. DAUM, Cincinnati.



PS Falls Flat on Its Stern

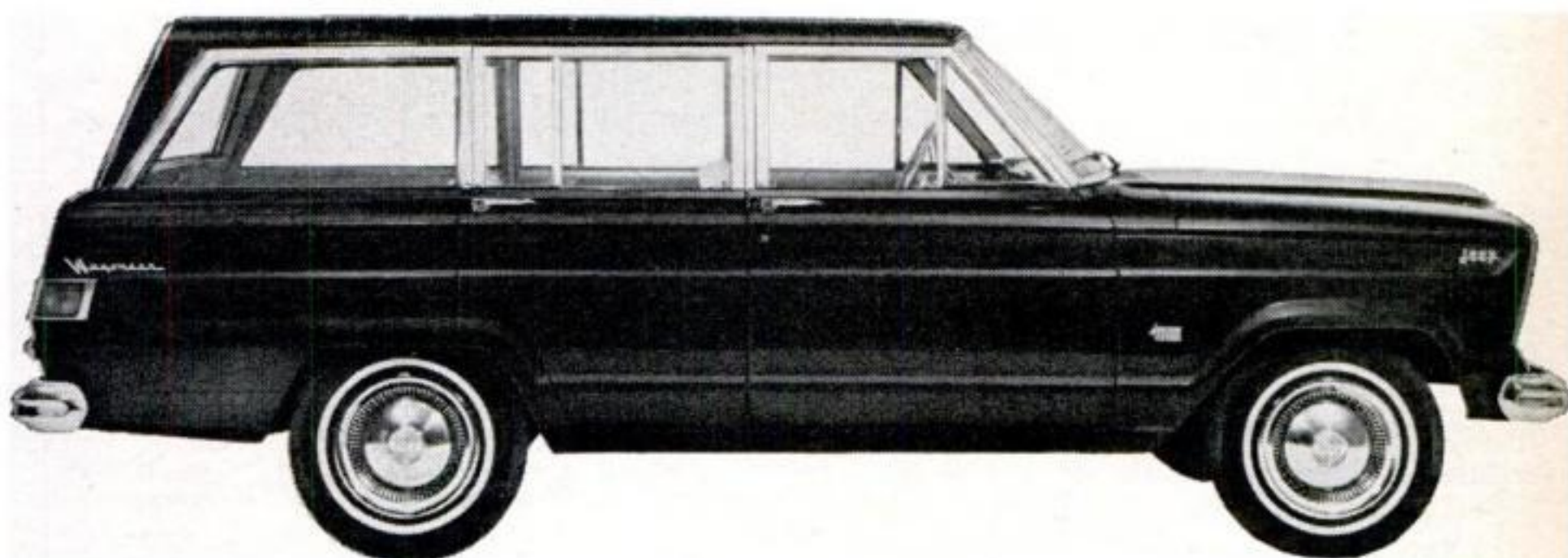
I enjoyed the very interesting and informative article "The Coast Guard's Worst Week" [Mar.]. I do object to the picture caption on the Gem's broken-off "bow." Any old salt knows that the presence of the stack, the flagstaff, and a short, rounded look mark the stern of a tanker.

FLOYD N. PRICE, Abilene, Tex.

Our copy editors who didn't know which end is aft are now getting instruction. Our editor, a Navy veteran, missed it, too.



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For every man who ever fell in love with a 'Jeep' — a new kind of family station wagon has been born. The 'Jeep' Wagoneer. It's the first station wagon ever built to offer the comfort, silence, speed and smoothness of a passenger car — plus the traction and safety of 4-wheel drive.

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Rocket experts compare notes—Dr. von Braun, left, and Kraft Ehrlicke of General Dynamics/Astronautics.

Dr. Wernher von Braun Answers Your Questions About Guiding Spacecraft to Other Worlds

Q *How is a spacecraft guided to the moon or a distant planet?*

A On the way, its aim is refined by a mid-course correction maneuver. This is a powered maneuver to correct any inaccuracies of its "injection" into its trajectory—the start it has been given by its launch rocket.

The term "mid-course" does not necessarily mean that this maneuver will be conducted at the halfway point to a celestial target. For propellant economy, it is advantageous to perform the mid-course correction maneuver well ahead of the midway point—in fact, the sooner the better. However, to give the corrected flight path the highest possible accuracy, it is necessary to wait long enough to track precisely and nail down the original uncorrected trajectory.

There may be just one mid-course correction maneuver—or several successive ones. One correction usually will suffice if accuracy requirements for the spacecraft's approach to its target are not too stringent. Missions involving extreme precision, such as orbital capture by the moon or a planet, are likely to require two or more corrections.

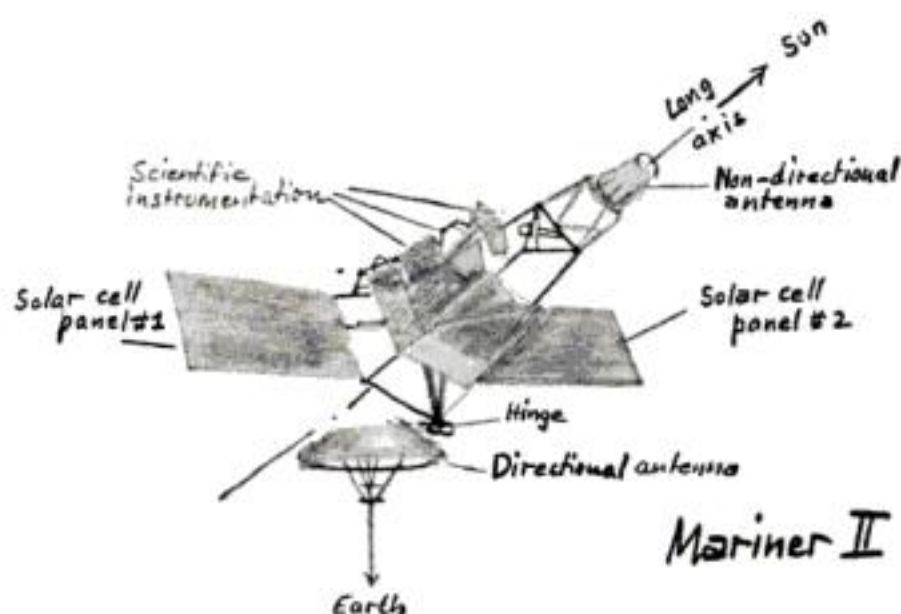
Q *How is the maneuver executed?*

A NASA's spectacularly successful Mariner II Venus probe provides a fine example:

Mariner II, a product of NASA's famed Jet Propulsion Laboratory, was launched

on Aug. 27, 1962, from Cape Canaveral. A converted Atlas D intercontinental rocket was the launch vehicle, and an Agena B served as second stage.

The Agena's rocket engine was shut down after Mariner II's successful injection into a parking orbit, 115 miles up. After a 13-minute coast along this orbit, the engine was restarted. It kept firing until the Agena B, with the 447-pound Mariner II spacecraft still strapped to



its nose, was injected into an escape trajectory toward Venus at 25,700 m.p.h. This occurred approximately over Ascension Island in the South Atlantic Ocean, about 25 minutes after launch.

About two minutes later, Mariner II was separated from the burned-out Agena; its aerodynamic shroud had already been jettisoned at Atlas burnout, five minutes after lift-off.

About an hour after launch, Mariner II was instructed, by radio command from the ground, to "acquire the sun." The spacecraft was equipped with six sun sensors (light-sensitive diodes) that

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provided a complete field of view, covering all directions. The sun, by far the sky's brightest object, could be mistaken for nothing else. The sensors, wired to the valves of a nitrogen-jet attitude-control system, turned the spacecraft until its long axis pointed at the sun.

Mariner II's butterfly panels with their 9,000 solar cells, unfolded by a previous radio command, were thus swung into position to be bathed in continuous sunlight. No longer did instruments depend on feeble chemical batteries.

One week after launch, Mariner II

About the drawings

In answer to readers who have asked, the illustrations accompanying these questions and answers are by Dr. von Braun himself.

When he began this column in PS, it was expected that drawings for it would be put in professionally finished form by a staff artist, using rough pencil sketches from Dr. von Braun for guidance.

As it turned out, the editors found Dr. von Braun's own informal sketches not only crystal clear in themselves, but as personal, direct, and authentic as if the famous scientist were chalking them on a blackboard before our eyes. Believing that you will find them so, too, we are illustrating his answers to space questions with direct reproductions of his original penciled drawings.

was instructed to aim its directional dish antenna toward the earth. During this "earth acquisition," the spacecraft maintained its lock on the sun. But it rolled on its long axis (pointed at the sun) in response to a short blast from the gas nozzles—and, with its dish antenna tilted at a preset angle, started "looking" for the earth.

Successful acquisition of the earth by the large directional antenna manifested itself by a sharp rise in signal strength. (Up to that moment, all communications had been through a separate, non-directional spacecraft antenna.) In this position, a small counterblast of the gas nozzles stopped the spacecraft's roll.

Mariner II now coasted along its unpowered trajectory toward Venus, sta-

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bilized on two axes—its long axis pointing at the sun, its directional antenna at the earth. In this attitude it began its mid-course correction maneuver—which was carried out, eight days after launch, on Sept. 4, 1962.

Up to this time, tracking data collected by three 85-foot radars—spaced far apart in California, South Africa, and Australia, for continuous coverage from the rotating earth—had been fed into an electronic computer [See "Ranger 6, Where Are You?" p. 64]. The computer compared the actual trajectory of Mariner II with the trajectory required to pass Venus at a distance of about 10,000 miles. Thus it provided data for correcting the actual trajectory, to offset its deviations from the desired one.

These data now were radioed to the spacecraft, in three distinct commands:

1. Roll through a certain angle about the spacecraft-sun axis.

2. Pitch up through a certain angle. (That is, turn the outer end of one of the two butterfly panels a bit more toward the sun, and the opposite panel's outer end away from the sun.)

3. Fire a little 50-pound-thrust motor until a certain velocity has been added in the direction of Mariner II's long axis. (The rocket motor could contribute up to 200 feet per second.)

With these three commands properly executed, Mariner II was "in the groove." To get its temperature control and communications system back in good shape, the spacecraft reacquired sun and earth. It remained in this attitude during the rest of its journey and its approach to Venus, when it activated its data-gathering instruments.

After a 180-million-mile flight, Mariner II passed Venus on Dec. 14, 1962, at a distance of 21,000 miles. It radioed back invaluable and unprecedented data, and lifted the first veils from the mysteries of this intriguing planet.

Q What are "ullage rockets"?

A They are a set of small rockets that assist in the start-up of liquid-propelled

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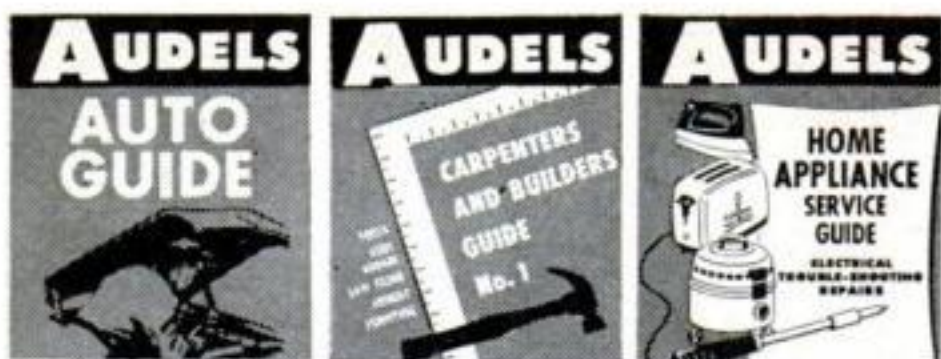
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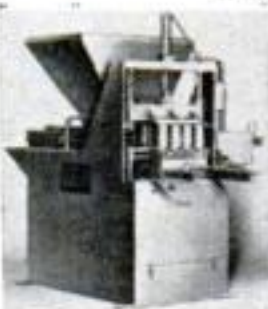


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upper stages of large-size rocket ships.

After shutdown of the first-stage engines, and prior to ignition of the second-stage engines, a multistage rocket ship coasts unpowered through the vacuum of outer space for a few seconds. Since its tanks and the liquid propellants in them follow the same unpowered trajectory, there is no differential force of any kind to hold the now-weightless fluids in place within the tanks.

As a result, the danger exists that the second-stage propellants may cling to the tanks' walls and the upper tank bulkheads, unporting the outlets to the rocket engines. When the pumps are started to feed the propellants into the second-stage engines, their intakes may, instead, suck in tank-pressurizing gas out of the ullage. (The term "ullage" denotes the gas pocket above liquid in a container.)

Ullage rockets serve to prevent this from happening. Their accelerating force keeps the propellants settled on the respective tank bottoms—and the ullage on top of the liquid where it belongs. These rockets fire for a few seconds only. They are ignited just prior to thrust termination of the lower stage, and stop firing after the upper stage's own thrust has been fully established.

It is customary to attach ullage rockets to the outer skin of the large rocket. Second-stage ullage rockets, having a one-shot task, usually consist of a set of two or four small solid-fuel rockets, which are sometimes jettisoned after use.

Ullage rockets for third stages, or for spacecraft-propulsion systems requiring several restarts, are often liquid propelled and combined with the attitude-control jet system. To prevent unporting of the rockets' own propellant outlets, so-called "positive displacement bags" separate the liquid propellants from the gas ullage.

Dr. von Braun will consider answering questions from readers of POPULAR SCIENCE in the magazine, but he cannot undertake to answer each one by mail. Letters to him should be addressed in care of POPULAR SCIENCE, 355 Lexington Ave., New York 17, N. Y.

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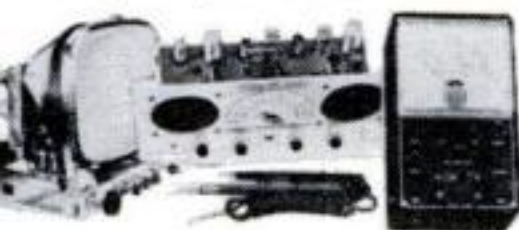


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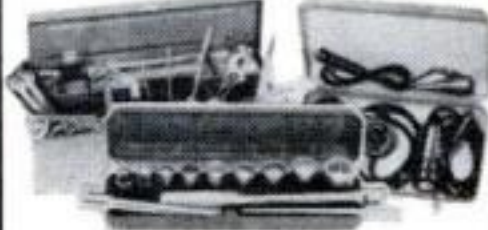
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Science newsfront

BY WALLACE CLOUD

A monthly report: What's going on in science and why it's important to you

MEDICINE

The pill with a moral influence

Contraceptive pills for men, which have finally reached the testing stage, may have a sobering effect on the social and home life of the American male.

Dr. Carl C. Heller of the Pacific Northwest Research Foundation, Seattle, announced that pills based on a diamine compound had been successfully tested on 39 prisoners who volunteered at Oregon State Penitentiary.

With pills taken on a one-a-day basis, the compound halted sperm production within 10 weeks, but had no lasting effect on fertility when the prisoners stopped taking them. If they go into production, the pills will cost less than a dollar for a month's supply, Dr. Heller said.

The only catch: Diamine has a side effect that makes it act somewhat like antabuse, a drug sometimes used in the treatment of alcoholism. If a man taking the pills drinks as little as a half-ounce of alcohol, his blood pressure rises, his eyes become bloodshot, and his vision is impaired.

A number of drug companies are hard at research trying to find some way to eliminate the side effect.

Fatal indolence

Idleness can kill you, report researchers Cedric R. Bainton and Donald R. Peterson, who studied deaths from heart attacks of people under 50 in Seattle and surrounding King County. In that area (population, one million) there were 133 heart deaths in one year: 122 men and 11 women.

The 122 men presented a "picture of indolence," the doctors reported. "Sixty-six percent customarily occupied themselves, for the most part, with television, reading, and visiting when not at work."

One surprising fact was uncovered by the statistics. Doctors have usually assumed that alcoholism and heart disease rarely go together. But the Bainton-Peterson report showed that 10 of the 122 men

were alcoholics, as were 3 of the women. Another 23 men drank about 30 ounces of whiskey (or its equivalent) a week.

Nature takes over. Everett "Red" Knowles demonstrates here that he can now move all five fingers of his hand, and can move his wrist in one direction. He's the 13-year-old whose arm was sewn back on after it had been cut off close to the shoulder when a bridge abutment scraped him off a moving train on May 23, 1962 [see "The Boy Who Lost His Arm and Got It Back," PS, Nov., 1962]. Everett's improvement is good reason for optimism, say his doctors, for true recovery depends on the slow regrowth of nerves in his arm. Many months of observation and treatment are ahead before doctors close the case.



THE SEA

Vacuuming the sea floor

Everybody talks about mining the sea for metals, but nobody—except the University of California—does anything about it. Dr. John L. Mero, a research engineer at the University's Institute of Marine Science, says that right now it would cost 50 to 75 percent less to produce minerals from the sea than from land deposits.

The reason: Instead of costly drilling equipment, shafts, and townsites, all you need is a hydraulic dredge—a giant vacuum cleaner—to scoop up the nuggets, using television cameras as guides.

At stake are rich deposits of manganese, copper, zinc, and other metals. "A single dredging operation could produce about 50 percent of the U.S. consumption of nickel, over 100 percent of cobalt," Dr. Mero noted. Furthermore, new deposits form faster than we can consume them.

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Science newsfront continued

ANTHROPOLOGY

Too much specialization?

Man—like the giraffe—may have stuck his neck out too far, says British anthropologist Louis S. B. Leakey. The threat is extinction.

It was a fine survival trait for giraffes to be able to eat the leaves on tall trees. But they're in trouble when they root around the ground for necessary mineral soils. A giraffe has to spread-eagle, then straighten up, and chew the dirt a full 15 minutes before it gets swallowed—a quarter-hour's

Fallout shelter in a bottle. Alcohol increases the body's tolerance for radiation, according to E. P. Blizard of Oak Ridge National Laboratories. So does eating ground glass, tests on animals show. "Any insult to the system" would work to some extent, he said.

vulnerability to its enemies, and it might choke to death during an attack.

Leakey contends that man's hands and brains are also instruments of overspecialization—creating the tools of self-destruction. But he adds that one specialized trait—intelligence—could also save him.

The scientist, famed discoverer of "Nutcracker" man in the Olduvai Gorge in Tanganyika, Africa, has recently returned with new fossil finds. In Kenya he uncovered animal remains dating back 14 million years. There were at least 26 new species, including dwarf giraffes, rhinos, and maybe an ancestor of the hippo. The discovery shakes theories that Africa was barren until animals came in from Europe and Asia.

CHEMISTRY

Rustproof steel in the stars?

Something in the stars may keep steel from rusting. Chemist W. R. Golliher of Union Carbide Nuclear Co. reports that the element technetium keeps steel sparkling even when exposed to water at 480 degrees F. for long periods.

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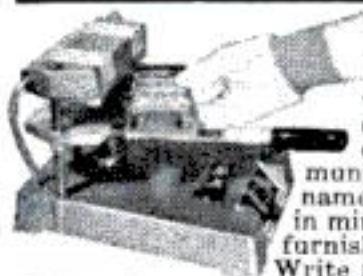
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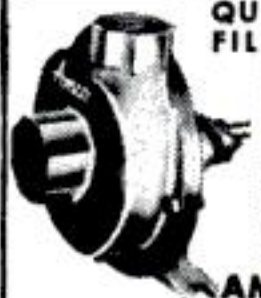
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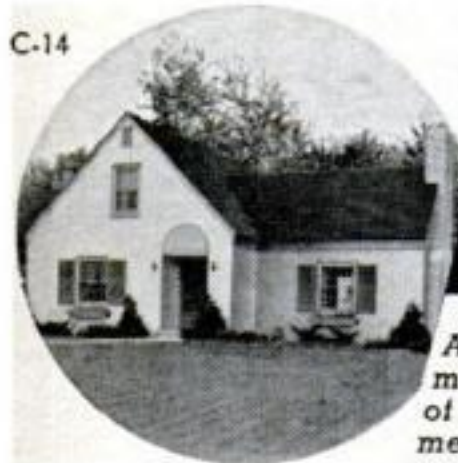
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Science newsfront continued

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BIOLOGY

"Bugs" to kill bugs

Is there a safe bug-killer? Department of Agriculture scientists think they have one. It's a "bug" too—a microbe, *Bacillus thuringiensis*—fatal to inch worms, gypsy moths, and forest tent caterpillars. It is said to be harmless to man and animals.

Dr. William E. Waters of the Northeastern Forest Experiment Station of the Department of Agriculture, and his colleague, Dr. Franklin B. Lewis, report that the bacillus apparently paralyzes the stomachs of caterpillars so they can't eat. Tests show it works well against some leaf eaters, but it's no good against nonleaf eaters. It's not yet on the market. [For other information on insecticides, see "How to Poison Bugs . . . but NOT yourself," page 106.]

THE MOON

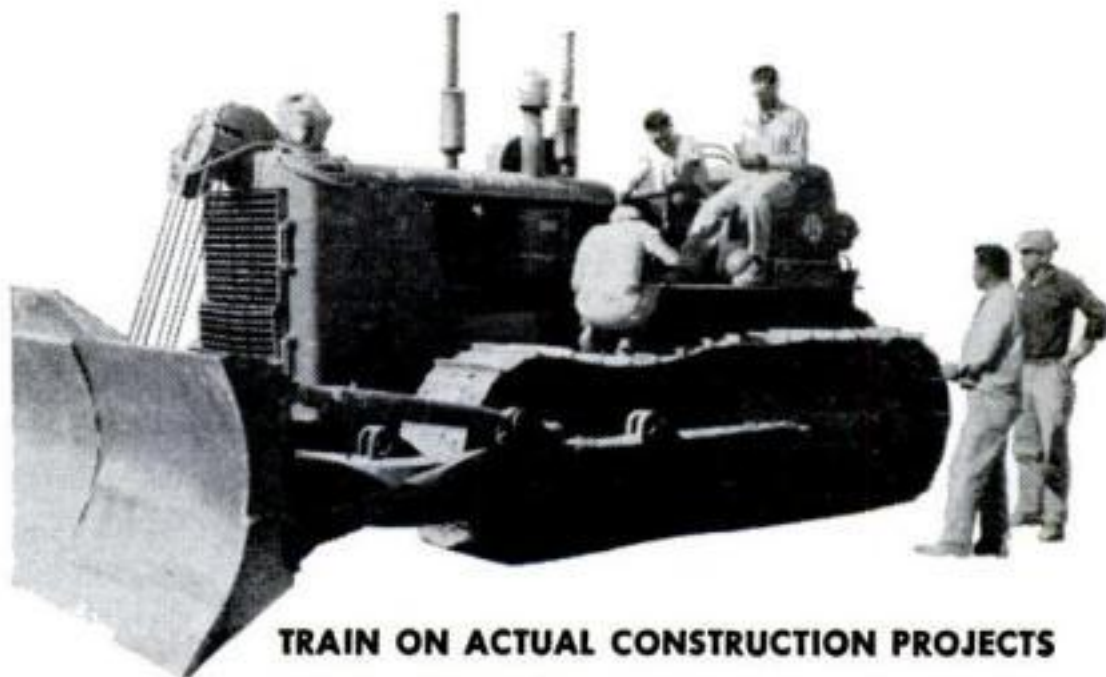
Our part-time lunar umbrella

With the failure of Lunik IV to make a soft landing—or any other kind of landing—back in April, the Russians appeared to have joined the select club of nations that have trouble hitting the moon. The field was clear for theorists who wished to muse on the nature of the moon's influence, with no messy scientific evidence to gum up their hypotheses. For example:

Why is there more heavy rainfall than usual in the week following the new moon and also in the week after the full moon? Confirmation of this folklore turned up last fall when American and Australian scientists independently and coincidentally analyzed rainfall records going back to 1900.

Now Dr. E. G. Bowen, one of the Australian researchers, has come up with the theory that the moon is electrically charged to about 10,000,000 volts. The charge acts as an umbrella to repel micrometeorite dust that the earth encounters in space—but only during the half-moon and three-quarter-moon phases, when the moon is lined up with the earth's orbit. The dust, Dr. Bowen thinks, enters the earth's upper atmosphere at other times to seed clouds and produce rainfall.

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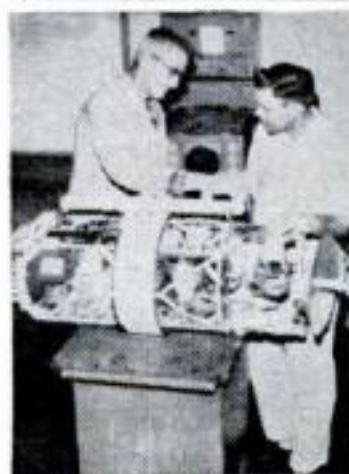
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Getting Ahead

By Dr. Lewis R. Fibel

A monthly column to help you prepare yourself for a better job

How much do scientists earn?

About \$10,000 a year, reports the National Science Foundation. That was the median annual salary for all U.S. scientists in 1962: Half the scientists in the country make less than \$10,000; half make \$10,000 or more.

How the figures break down, by field, is shown at right.

FIELD OF EMPLOYMENT	TOTAL
Chemistry	\$11,000
Physics and Astronomy.....	11,000
Biological Sciences.....	10,000
Mathematics	10,000
Agricultural Sciences	8,000
Psychology	9,000
Earth Sciences	10,000
Meteorology	8,000
All Fields	\$10,000

Going to be looking for a summer job? As a guide you might want to look at a 66-page booklet, *Summer Jobs* (The Advancement and Placement Institute, 169 N. 9th St., Brooklyn 11, N.Y., \$4). This is an annual publication compiled especially for teachers

and college students. It lists the kinds of jobs at which you can earn while learning or vacationing. The directory is not exhaustive, but seems accurate and up-to-date. It also presents information about permanent jobs as well as summer jobs and special projects.

"I'd like a job working on heavy equipment. Is this a good field for someone to break into? What schools offer training?"—J.E.S., Rochester, N.Y.

I interpret your question to mean you are interested in operating heavy construction machinery such as power shovels, cranes, derricks, and bulldozers—in other words, you want to be an "operating engineer."

There should be a growing demand for persons skilled in these fields because of the expected increase in all construction activity and, in particular, in highway-building. It seems clear, too, that more specialized and complex machines, requiring a higher level of training to operate, will be developed. Skilled workers now get up to \$5 an hour for such jobs, making them among the highest paid in the building trades. Self-employment is also possible. In short, a fine field for a young man.

The following schools offer resident training as well as home-study courses:

Interstate Training Service, 4035 N.E. Sandy Blvd., Portland, Ore.

National Technical Schools, 4000 S. Figueroa St., Los Angeles 37.

Tractor Training Service, 1525 E. 53rd St., Chicago 15.

These schools offer resident training:

National School of Heavy Equipment Operation, Dept. A-36 P.O. Drawer 1686, Charlotte, N.C.

Western School of Heavy Equipment Operation, Dept. S-2, Box 510, Weiser, Idaho.

"I have an A.B. degree in industrial psychology. I would like to use it, with additional training, as a springboard from government service to private industry. How can I obtain additional skills? I would like a career with broader employment possibilities, reasonable advancement, and, preferably, one that can be acquired by home study."—A.J.T., San Francisco.

Without additional information I can't answer your question fully. I would suggest that you consult a vocational-counseling service, perhaps one attached to a local college, to get supplemental information or to arrange for testing to determine your aptitudes.

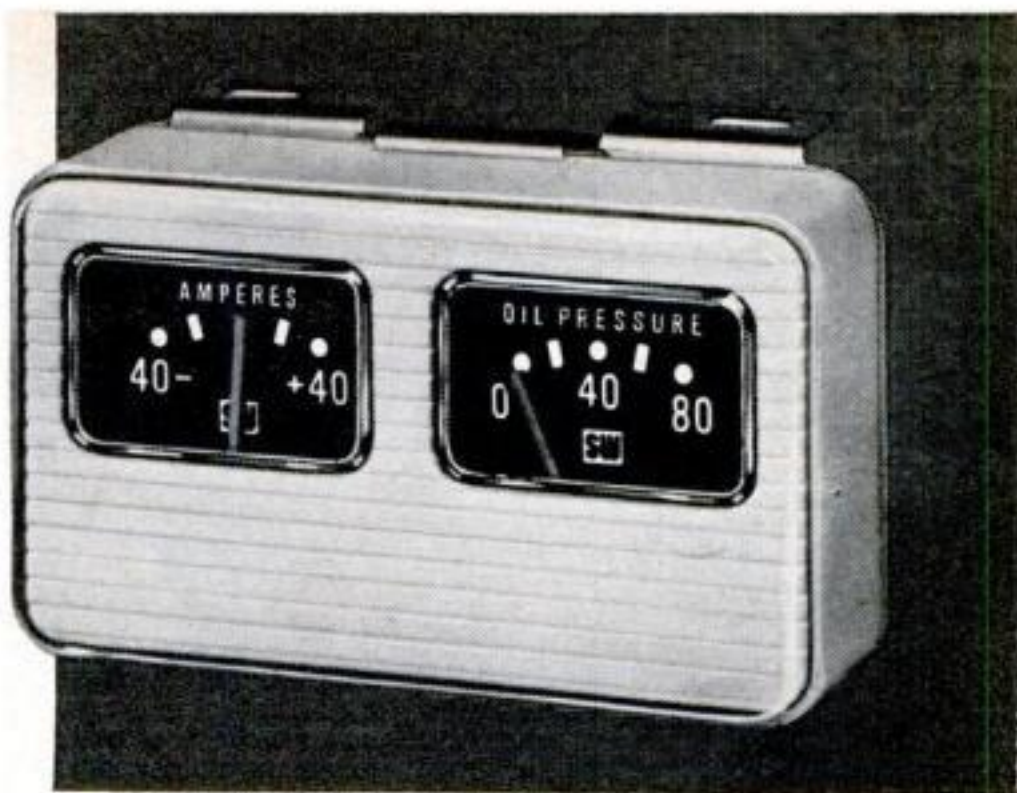
However, I can list some fields that you



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mechanics for checking engine performance ...and the S-W *Volt-Guard*, a special gauge for checking battery condition, generator and voltage regulator. Ask your dealer about the full-line of reliable Stewart-Warner Custom Gauges...from the most complete line of automotive instruments in America.



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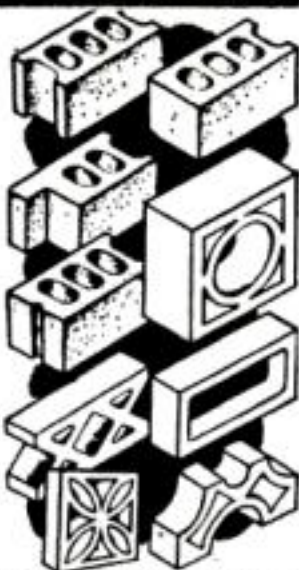
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might consider. All of these can be studied at home. I have also noted some schools that offer such programs.

Accounting: International Accountants Society, Inc., 209 W. Jackson Blvd., Chicago 6.

LaSalle Extension University, 417 S. Dearborn St., Chicago 5.

Industrial Management: International Correspondence Schools, Scranton 15, Pa.

Lincoln Extension Institute, 1401 W. 75th St., Cleveland 2.

Personnel Management: LaSalle, International, and Lincoln (addresses listed above).

"I understand some association publishes a list of correspondence schools. May I have the address?"—R.M.O'C., Belmont, Mass.

The National Home Study Council, 2000 K St. N.W., Washington 6, D.C., issues a directory, *The Home Study Blue Book*, which lists accredited, private, home-study schools.

"When I enter high school next fall, I'd like to go to one of the more technical schools in my area. But I hear that it's harder to get into a college from a specialized school because of the competition. I am confused and would like to know what to do."—A.R., Forest Hills, N.Y.

You certainly can get a good education at a specialized high school. But you can at a general high school, too. To a great degree, how "good" your education will be depends on what you, as a student, will put into it.

Whichever you choose, you should not base your decision on fear of not making college. Your chances for that will depend on standard tests like those of the College Entrance Examination Board, and your high-school record—which will have to meet certain standards no matter what school you attend.

"Where can I study job evaluation and description?"—M.W., Camby, Ind.

Lincoln Extension Institute, 1401 West 75 St., Cleveland 2, is one place.

Send your questions on careers and technical training to:

Getting Ahead Editor, **POPULAR SCIENCE**
355 Lexington Ave., New York 17, N.Y.
Not every question may be used. Questions cannot be answered by individual letters.

30 **POPULAR SCIENCE** JUNE 1963



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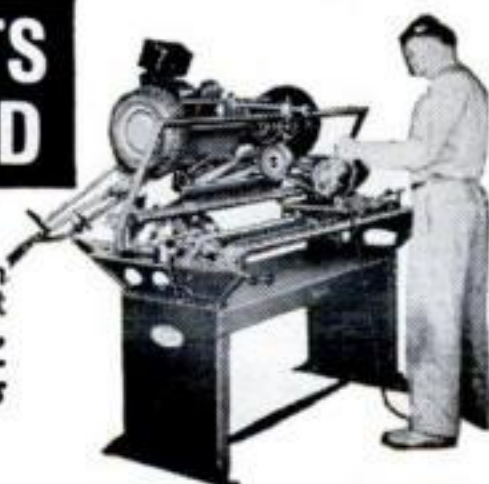


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Detroit report

By Devon Francis

You'll wonder where the yellow went

Ford Motor Co.'s drive to produce a true 100,000-mile car will take a giant step forward this summer with a revolutionary electrostatic anti-rust dipping process for Lincoln and Thunderbird bodies.

As the body travels through an 80-foot tank, an extremely high charge (said to be up to 50,000 amps) etches the bare metal and bonds the primer. The car bodies will be negatively charged; the paint-water-acid in the tank positively charged. This reportedly will cause the molecules in the steel to open up and close around the molecules of paint.

Antique parts for sale

Where would you find wood-spoke wheels for a 1931 Chevrolet? Or door handles for a 1928 model? Try your Chevy dealer.

Chevrolet has instituted a parts-exchange system among its dealers to fill the needs of antique-car enthusiasts. Parts sales managers publicize particular needs in a nationally circulated listing, eliminating months of correspondence between dealers.

Listening for leaks

A device like a doctor's stethoscope has been produced in England to trace air leaks. The Air-escope is said to spot trouble in manifolds, gaskets, exhaust systems, air lines, and tubeless-tire rim seats. Sonicaid Ltd., of Hounslow, Middlesex, reports that in tests on an air cylinder with a pressure inside of three p.s.i., air escaping from a .001-inch pin-hole could be heard easily.

Kerosene for a V-8

Back in 1921, Henry Leland, a famous name in Detroit, built a Lincoln car that

became the prototype for production-line models in 1922 when Henry Ford had taken it over. It had a V-8 engine with exhaust pipes snaked through the V's center to heat the intake manifold—necessary with the low-grade fuel available in those days.

Now Leslie R. Henry, Curator of Transportation at the Henry Ford Museum in Dearborn, has had the old car restored. It runs like a sewing machine. But the engine can't stomach today's high-octane fuels. The carburetor develops vapor lock. So a diet of five parts gas to one part fuel oil—little better than a high-grade kerosene—must be used to accommodate the heat from that exhaust plumbing.

Henry, who is also technical vice-president of the Antique Automobile Club of America, plans to drive the old Lincoln to Colorado Springs on the 1963 revived Glidden Tour.

For women only

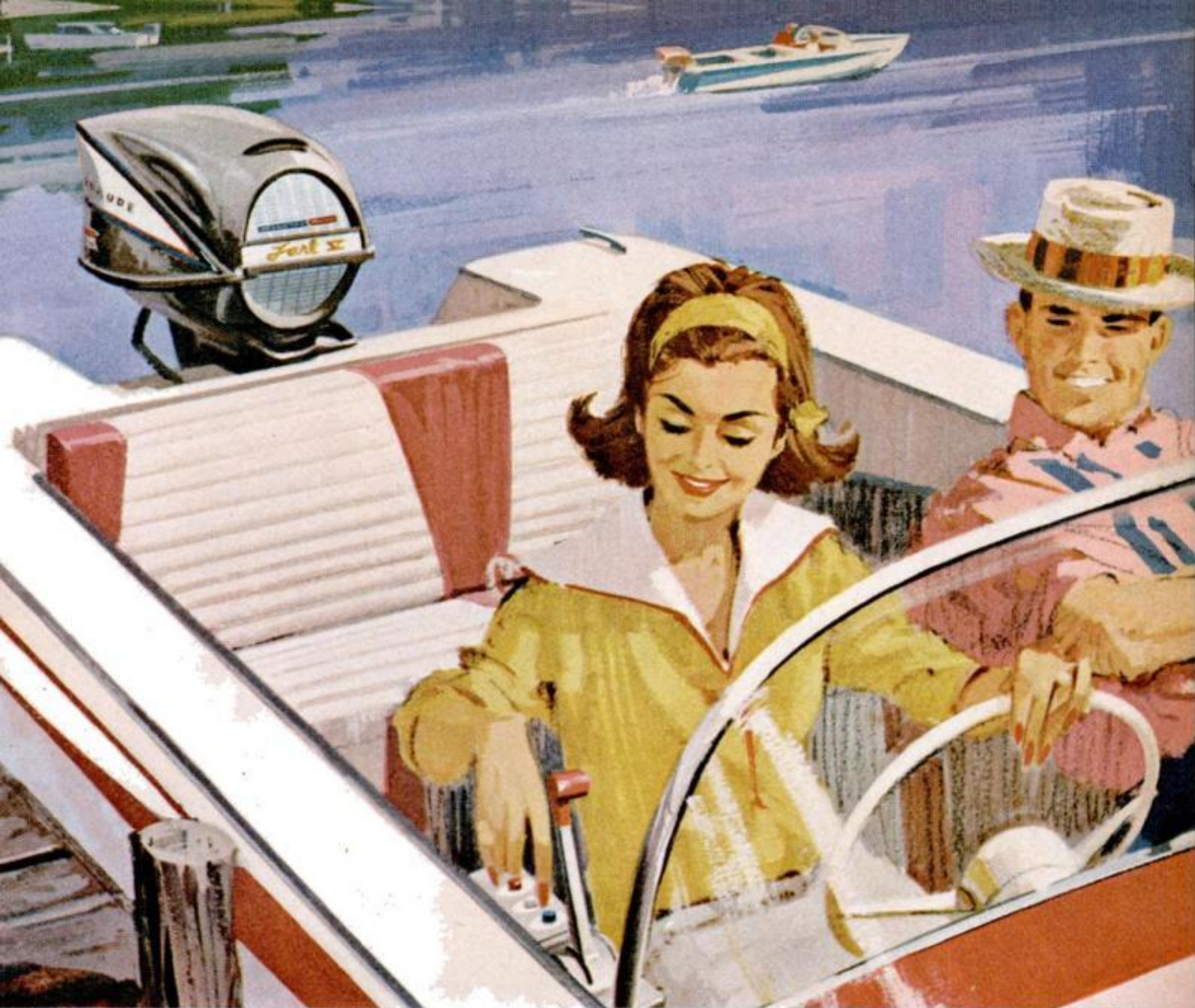
Detroit's stylists are off on a new track. They're designing cars especially for women, incorporating different color schemes, makeup kits, seats that are higher and farther forward, and plenty of power accessories. You may see them in three or four years.

To drink and drive

Donald S. Buck, safety director for the U.S. Army Continental Command, Fort Monroe, Va., is described as an iconoclast and realist. Says he: People should be taught how to drink and drive, and how to drive faster safely.

Addressing a fleet-maintenance conference in Chicago, he stated, "We all know people have a few drinks and then drive their cars. We should be teaching them just how much to drink. We give driver tests that consist of driving around a block at 20 miles an hour, and then turn people loose on superhighways. We know under what conditions people drive, so we should adequately prepare them to meet these tests."

His estimate of traffic-accident costs in the U.S.: \$2,314 a second.



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You're underway. Just feed the gas and steer.

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Suppose you want to stop at a dock.

Slow down. Ease up on the gas. Pick out a spot. Forget about the throttle. You won't need it for docking.

Click — you're in neutral, Click — you're in reverse (for braking). Click — you're in neutral again, ready to tie up.

Suppose you goof?

Click.

Nobody will ever know — the hand is quicker than the eye.

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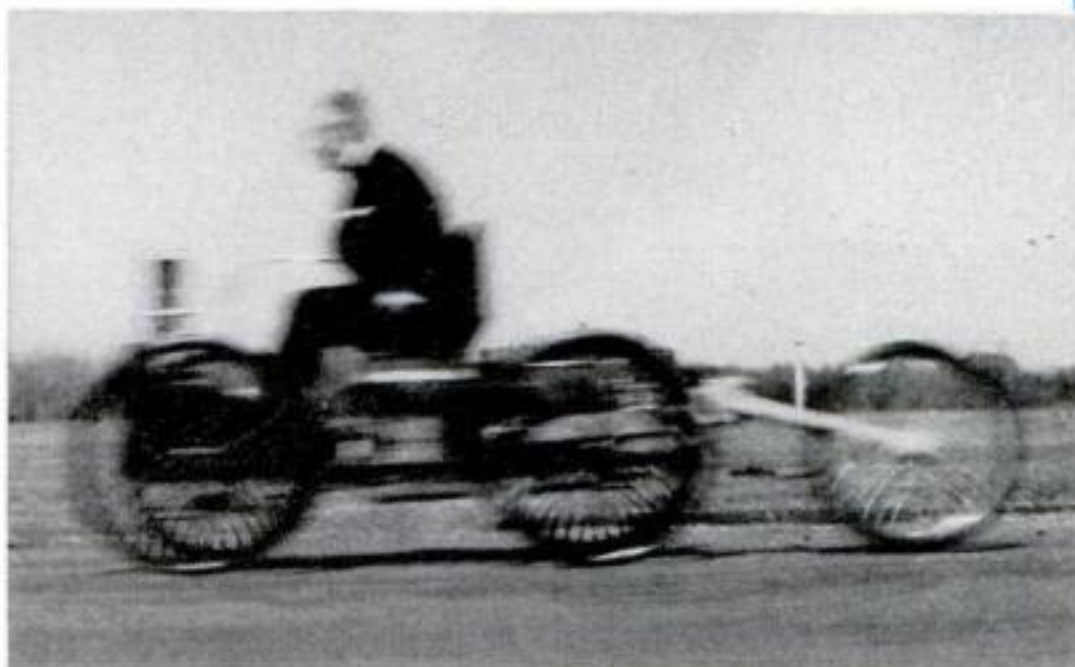
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**Popular
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REG. U. S. PAT. OFF. Monthly



Our dauntless driver streaks by in a blur—at 18 m.p.h.

Devon Francis test-drives a reproduction of Henry Ford's first car. Want a thrill? Climb aboard

One hundred years ago next month a man was born who was to play the major role in putting America on wheels. He was christened Henry Ford.

To celebrate this centennial, POPULAR SCIENCE sent its automobile editor to Dearborn, Mich., home of the industrial empire bearing its founder's name, to test-drive Mr. Ford's first car, the Quadricycle.

It was before dawn on June 6, 1896, that Mr. Ford pushed his new-born steed out of a brick coal shed behind his residence at 58 Bagley Ave., Detroit, and piloted it for the first time under its own power along the city's streets.

At the more civilized hour of 1 p.m. on April 13, 1963, Mr. Francis climbed aboard a just completed reproduction of it. Here is his report.

By Devon Francis

I HAVE just driven a vehicle that for sheer simplicity of design could give aces and kings to the automobile industry, hands down.

On its very first run, I sat beside its builder, Mr. George De Angelis. A proud man, Mr. De Angelis took the controls. We were push-started by friends.

CONTINUED

**PS
Tests
the
1896
Ford**



In bowler hat, test-driver Francis poses in Quad before shed where Ford built his first car.



Here's Henry Ford—also in a bowler—in his Quadricycle. He had to knock out part of a doorway to get the machine out of the coal shed.

Surprised at this gambit, I asked, "No starter?" "The electric starter," replied Mr. De Angelis patiently, "has not been invented yet."

After a few gasps, the engine caught. It sounded rather like a gas-powered chain saw. We drove a couple of blocks, came about, and returned to our starting point.

"Would you care to drive it?" Mr. De Angelis asked graciously as he dismounted.

I grasped the tiller and pulled part way back on the control lever. There was some slippage on the drive belt, but the car accelerated pleasantly if not—let us say—briskly. Speed, with the "clutch" partly engaged, was, perhaps, five m.p.h.

Driving in a circle, I called to Mr. De Angelis, "I presume that to reach high gear, I push for-

[\[Continued on page 180\]](#)

Facts on the Quadricycle

Model: Quadricycle Buckboard

Engine: 2 cylinders, horizontal and parallel; 4-cycle; F-head; 3-4 hp. (approx.) at 800 r.p.m.; maximum torque not announced; compression ratio, 3:1 (approx.); bore and stroke 2.5 by 6 in.; displacement, 71.9 cu. in.

Curb weight: 500 lb.

Transmission: 2-speed; belt drive from fly-wheel, actuated by lever, idler pulleys.

Steering: tiller travel, 38 degrees lock to lock; overall ratio, 1:1; diameter of turning circle, 20 ft., 4 in.

Effective brake-lining area: 22.5 sq. in.

Outside dimensions: wheelbase, 49 in.; overall length, 79 in.; height 43 in.

Inside dimensions: hip room 25 in.; headroom, infinite; leg room 39 in.

Tire size: 1.75 by 28.

Speedometer error: What's a speedometer?

Gas mileage: 36.4 m.p.g. at 16.5 m.p.h.

Acceleration: 0-10 m.p.h. . . . 12.5 sec.

0-18 m.p.h. . . . 21 sec.

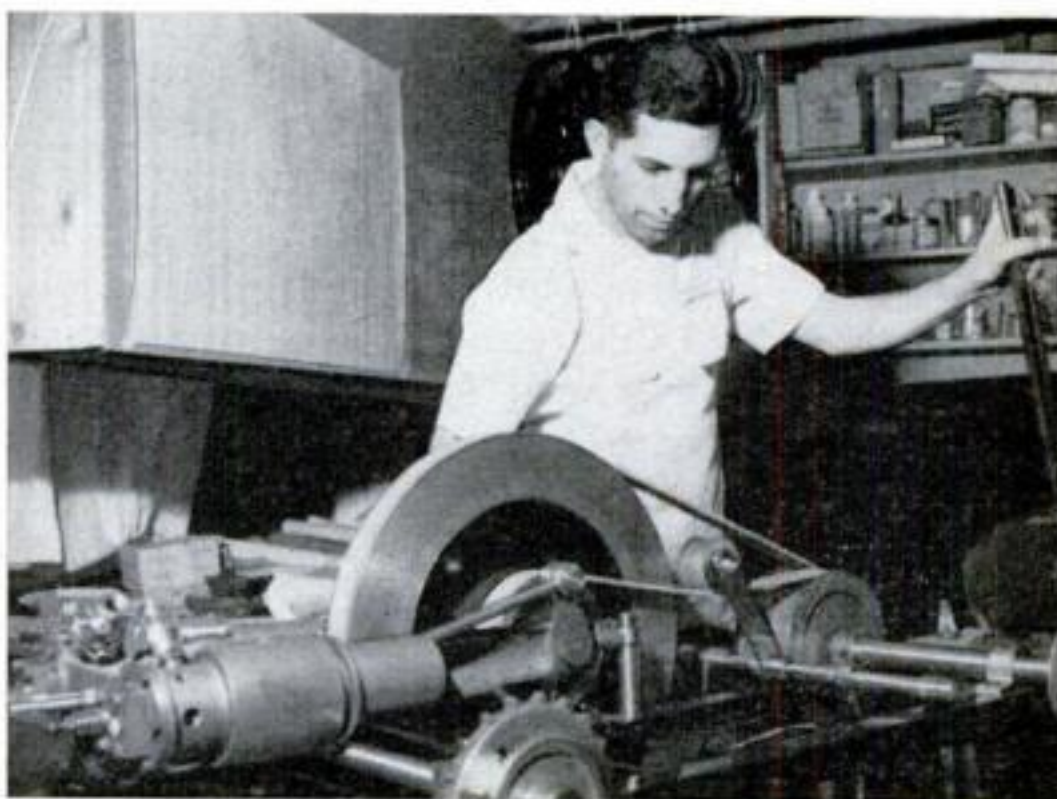
10-18 (passing speed) . . . 8.5 sec.

Top speed: 18 m.p.h. (actual, not estimated).

How I built my wonderful 3-hoss shay

By George De Angelis

About the author: George De Angelis, 42, is a former tool-and-die maker, turned artist. An antique-car buff, he restored a 1931 Ford Model A pickup truck which won several blue ribbons. In his garage now, in process of restoration, are a 1930 Model A sedan and a 1911 Model T. With time out for World War II, De Angelis has worked for Ford Motor Co. in Dearborn, Mich., a Detroit suburb, for 22 years. As a soldier, he was a tank mechanic with Gen. George Patton's Third Army. He is now a section supervisor in the Ford engineering staff art department.



WITH time, patience—and money—you can build your own car. I know. I did it. It took me almost three years, working nights and weekends. The car is a “compact.” It's small; it has a rear engine; it has tubeless tires.

And it was built on a design 67 years old. So what's new?

My compact is known as the Ford Quadricycle. To the knowledge of the Henry Ford Museum in Detroit, which collaborated with me, there are only two

Ford Quadricycles in the world. The other one, built by Henry Ford, is the original, under lock and key in a glass case at the museum.

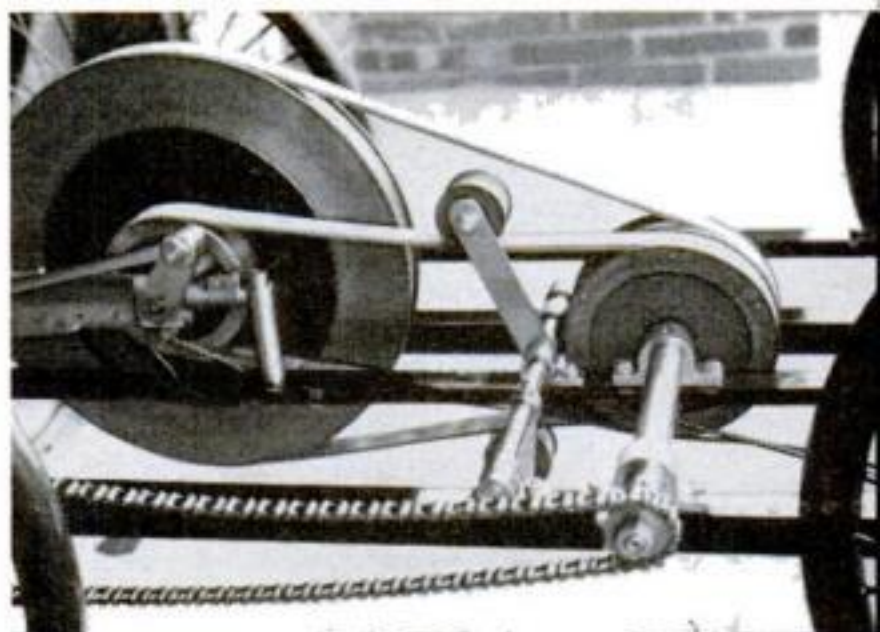
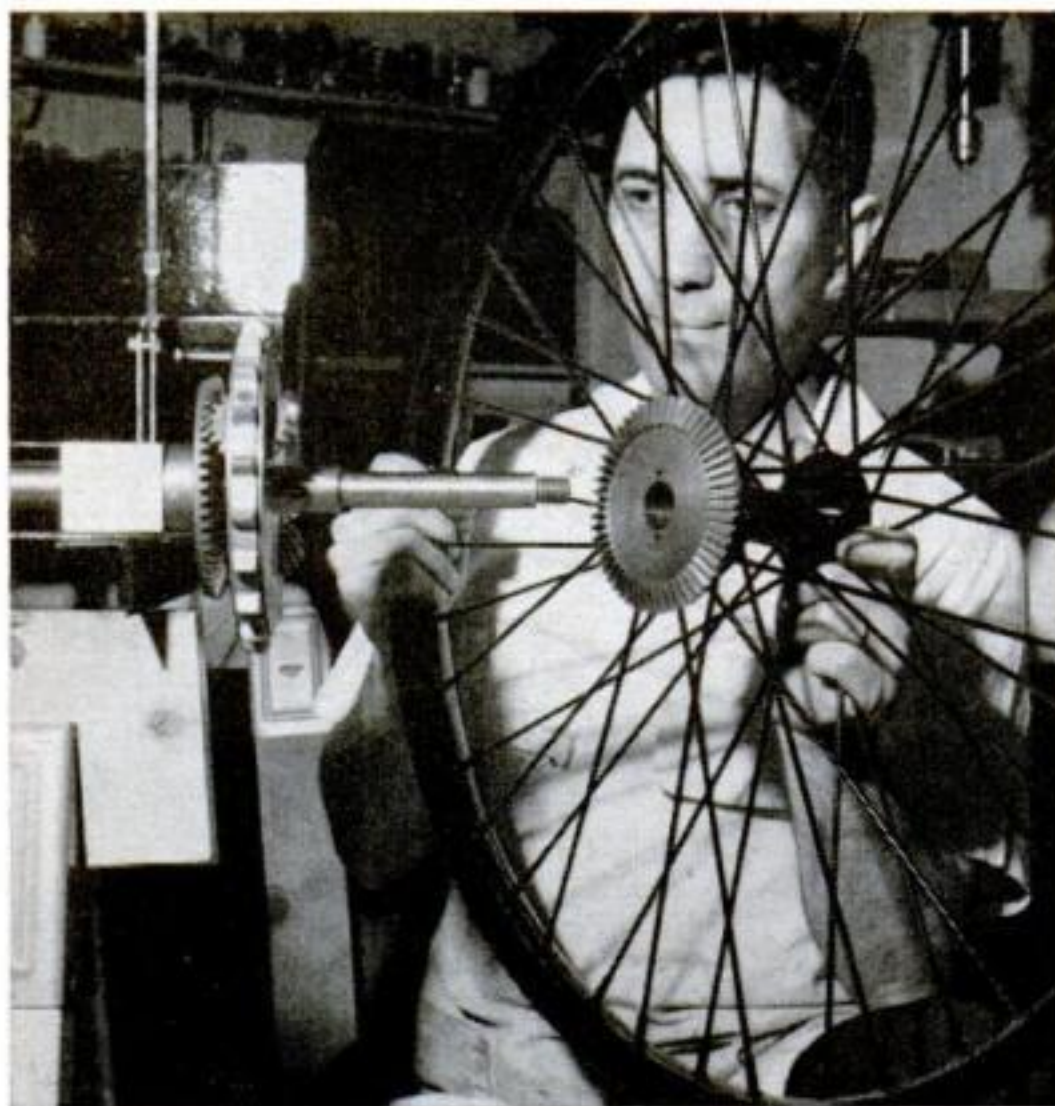
Reproducing Mr. Ford's car would—I thought—be simple. It consisted mostly of angle iron and welded and brazed tubing. This would be a one-winter project. I could have it on the road in the spring. Little did I know!

Mr. Ford's first car was a true horseless carriage in the mode of the day, with a tiller for steering. It had an angle-

CONTINUED

37

"The horsepower was 3 to 4. The engine was..."



The "gear" changing machinery in the power train is merely a lever operating idler pulleys that put tension on the belts.

The differential, a standard item, carries two spider pinion gears in the rear sprocket. The block bearing is bronze. The ratio between sprockets is 3:1.

iron frame, a wooden body (what there was of it), bicycle-type wheels, a four-cycle engine with two cylinders lying flat in parallel, a two-speed, leather, belt transmission, and a chain drive to a solid rear axle with a differential just inboard of the right rear wheel. The connecting rods are attached to cranks on a big fly-wheel, also in parallel with the cylinders.

I ASKED the Ford Archives and the museum for blueprints on the Quadricycle. To my astonishment, there weren't any. I wasn't discouraged, even when the museum gently suggested that the original Quadricycle was too precious to remove from its glass case for examination.

So I would get my dimensions another way. I read every bit of literature on the Quadricycle that I could lay my hands on and obtained about a dozen photographs. Then, putting a plastic triangle against the glass case and sighting like a surveyor, I did a careful walk-around, marking distances between the Quadricycle's components on the glass with pieces of masking tape. Measuring between tapes gave me my figures. The

innards of the engine didn't bother me—I was sure the museum would let me get at that later. Besides, what could be complicated about it? Ah, the bliss of ignorance!

I spent that first winter just making drawings.

Oh, well, I'd build the car the second year.

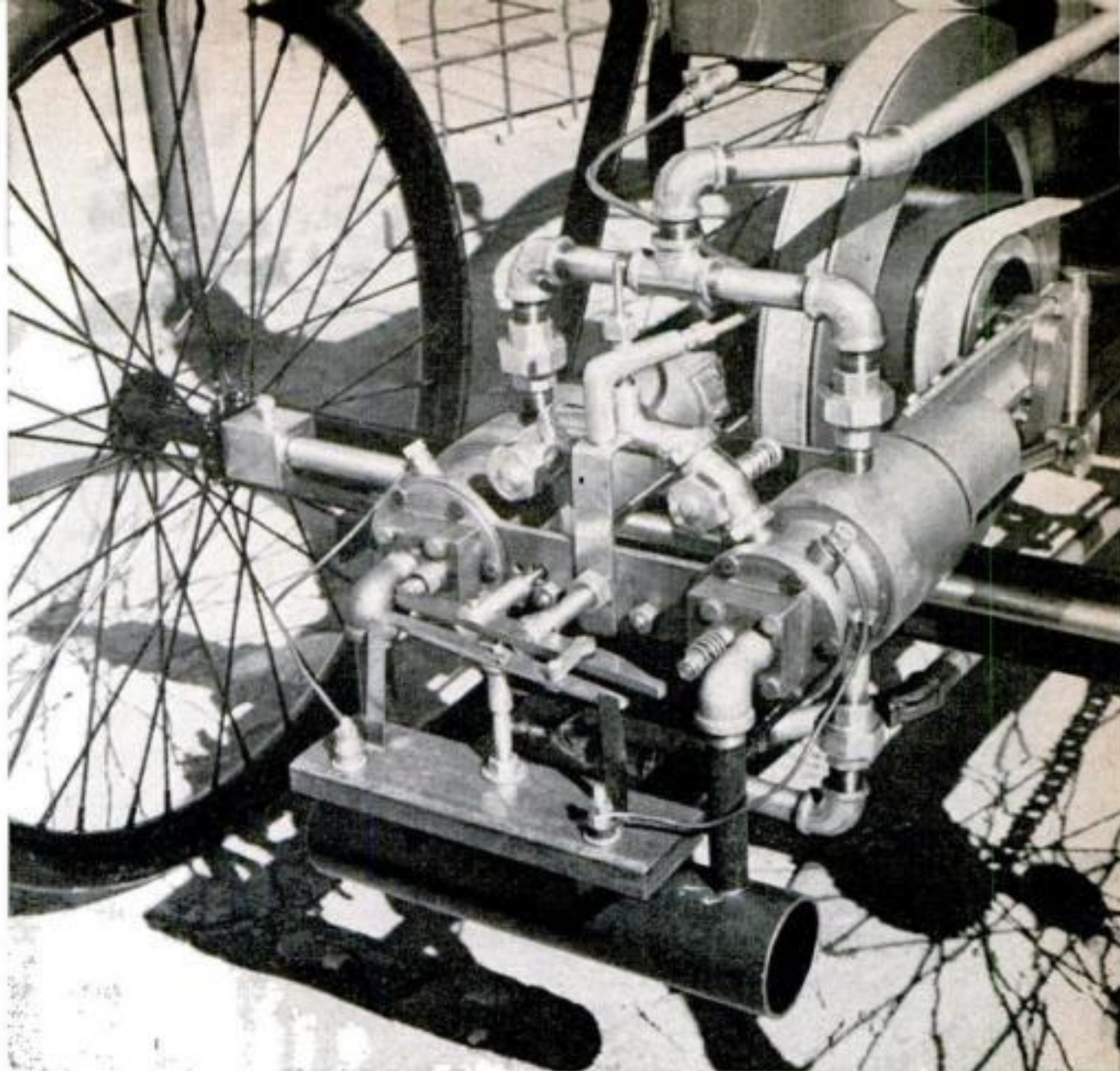
The chassis and body were no sweat. By December, 1961, the Ford Museum had decided that if I was determined to reproduce the Quadricycle, the vehicle had better be right. While the museum has no connection with the Ford Motor Co., it guards sternly all the treasures of the man who founded the Ford industrial empire.

When its officials did remove the Quadricycle from its case, I discovered that I had made only one error in my masking-tape operation—the transverse shaft carrying the power sprocket was $\frac{1}{8}$ -inch off in my drawings.

I TACKLED the engine. The horsepower, a pure estimate, was 3 to 4. The engine was, in a sense, an F-head, common to the rudimentary internal-

an F-head"

I bolted the two cylinders together exactly as Mr. Ford did 67 years ago. Today they would constitute a cylinder block 18 inches long, without heads. But only 11 inches of this actually is cylinder—7 inches is a skirt that is bolted on the main bearing. The compression ratio is hard to figure because of projections into the heads. The pistons come to top dead center together—while one is on the intake stroke, the other is firing. The throttle is a push-pull wire.



combustion engines of its day. The intake valves were atmosphere-operated and were housed in a modified, brass, one-way plumbing valve attached to the side of each cylinder by a half-inch pipe. A second half-inch pipe connected the two valves acting as intake manifolds. On this was soldered a $\frac{3}{8}$ -inch pipe as a carburetor. A needle valve served as a fuel control.

By progressively pinching down the pipes Mr. Ford had obtained the proper fuel-air mixture.

An exhaust valve in each head was operated by a rocker arm. A push rod, actuated by an eccentric geared to the camshaft, was attached to the rocker arm. The exhaust system came strictly from Mr. Ford's considerable experience with steam engines.

I bought $2\frac{3}{8}$ -inch-diameter seamless-steel tubing of $\frac{3}{16}$ -inch wall thickness for the cylinders and bored them out to $2\frac{1}{2}$ inches. On these I brazed water jackets. The brass one-way valves have not changed since Mr. Ford's day. I bought them at a plumbing-supply shop. These I drilled to take the intake-valve stem and spring. It was no trick to buy

the bronze gears for the exhaust-valve timing and fashion the push-rod and rocker-arm assembly.

I searched the power-lawn-mower catalogues for valves and pistons of the proper size, and finally was able to buy exactly what I needed. The $12\frac{1}{2}$ -inch-long connecting rods were really nothing more than solid round stock with bosses on each end for the wrist pin and crankshaft. For appearance, I made these from stainless steel.

Except for the pistons, all the machinery had to be drilled for hand-oiling. The pistons would be lubricated by old-fashioned steam-engine "bottle oilers." A friend found a pair of these for me by merest chance in an antique shop. They were exactly like those used by Henry Ford.

The construction of the ignition system inside the cylinders had puzzled me. I got the answer when the museum took the heads off. It was the old make-break system with a low-tension, hand-wound coil, and a dry-cell battery. The timing was simplicity itself—a pin on the top of each piston interrupted the

ground on the coil causing an arc in an electrode, or "igniter."

In this system the pin on the piston is moving slowly as it nears top dead center. The points open slowly and the arc is poor. That makes an engine start hard. I substituted a Model T coil to get a hotter spark. I positioned a pin on the crankshaft to make the ground on the coil just before top dead center. Finally, I put in conventional spark plugs. By removing the porcelain insulators, I made them look like the original electrodes.

I had the flywheel made—my lathe wasn't big enough to turn it. In the rough it weighed 100 pounds. Machined down, it weighed 89. A groove on the perimeter made the flywheel also a pulley for a transmission belt. A small pulley on the side turned a second belt. These would produce "high" and "low" gears.

I had thought that buying the belts would be simple. It wasn't. I finally located a one-man shop to do the work. Mr. Ford's were stapled. Mine were cemented. The man who made them reminded me: "You put the smooth side against the pulley for grip."

It was a good thing he told me. I'd probably have done it wrong.

SPROCKETS and chain for the drive just had to be easy to come by. They weren't. Hardly anybody made "block" type industrial chain any more. Ferreting out leads—which often came from Antique Automobile Club acquaintances—brought me to the Diamond Chain Co. of Indianapolis. Yes, they wrote, they had the chain but not the sprockets. However—and my heart jumped—they had the tools to make the sprockets. Just send them the specifications.

The belts from the flywheel needed two wood pulleys bolted to an intermediate drive shaft which would be keyed at one end to the drive sprocket. These I turned on my lathe.

Here I made a second and last modification. No record could be found of Mr. Ford's Quadricycle having had any brakes. For safety I wanted one; but I wanted to hide it. I found a drum from

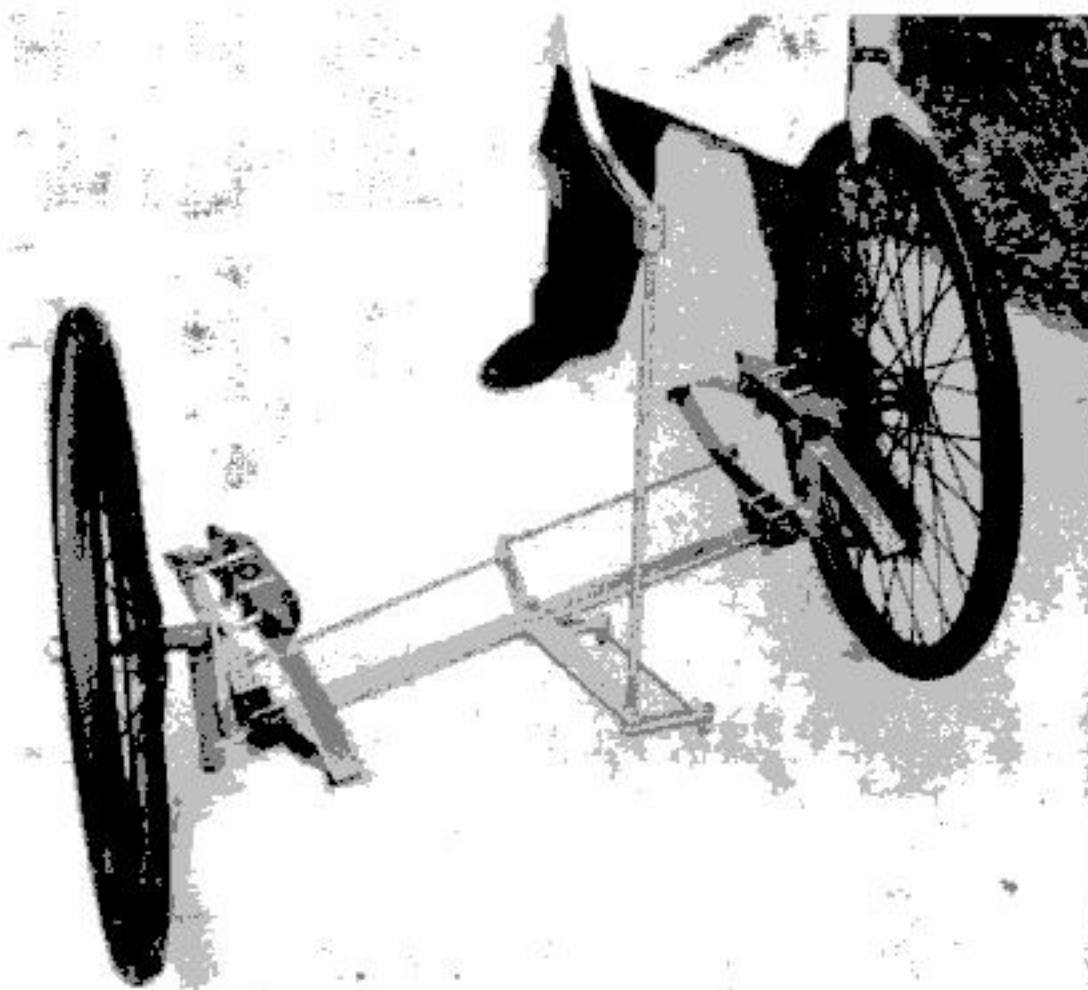
a propeller-shaft-type emergency brake used on a 1954 Plymouth. With some machining, it fitted snugly inside the drive-shaft pulleys.

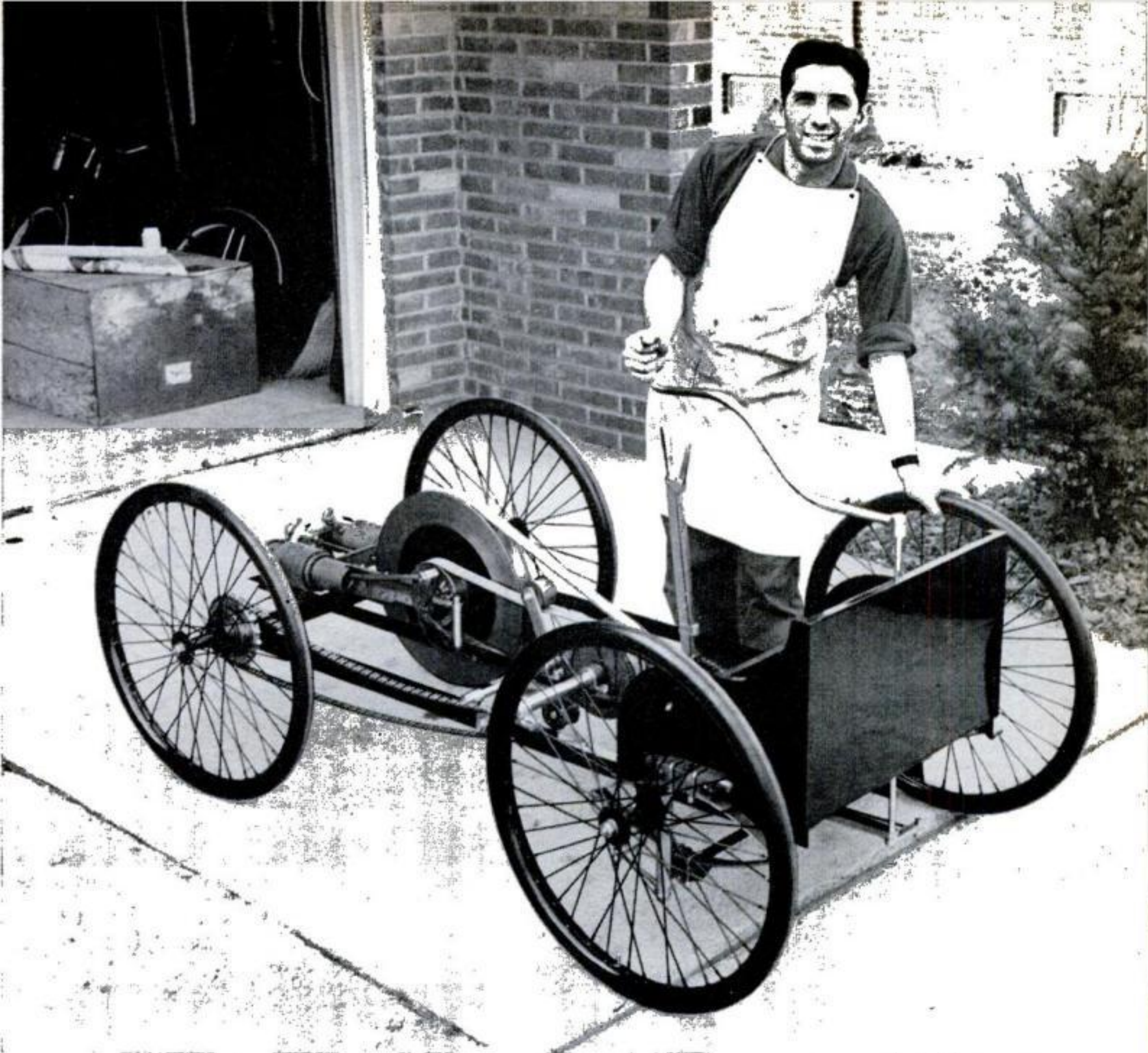
Then the Quadricycle needed wheels. The Ford had used bicycle-type wheels with rims big enough to accept a bicycle tire plus an extra tire carcass wrapped around and stitched to it. (After all, this contrivance weighed 500 pounds!) I turned the ends of some 1½-inch-diameter tubular-steel stock for the hubs and had flanges welded to receive the spokes. I bored and reamed the hubs to take the axles—steel-on-steel, with no bearings.

The wheel rims had to be "spun" from 100-gauge hot-rolled steel, and it was a job to locate a shop that could manufacture a 28-inch wheel. I had expected that spoking the wheels would be a problem. Again I searched. In the end, Dayton Wire Wheel Products of Xenia, Ohio, one of the few companies still in the business, "laced" my wheels.

NOW the tires. They had to be 1.75 by 28 and, to be faithful, completely bald. If the Ford Museum would

Steering geometry, made from solid stock, is conventional. I machined and drilled my own rods. The upright steering shaft has a U-bearing on the dash.





I first fired up my engine last April 11. It took time to get a good fuel-air ratio.

be interested in a few new shoes for the old Quadricycle, Firestone Tire & Rubber would foot the bill for the mold. I got my tires.

The seat was upholstered by Leonard Davis of Pontiac, Mich., in a diamond-tufted pattern common to buggies of 60 years ago.

The rest of the job—happy day!—came fairly easy. I machined the drop-type front axle. The kingpins were simple—there was no inclination to worry about, or caster or camber. A spring company made my front leaf springs. (The rear of the Quadricycle is wholly unsprung.)

A boiler factory bent my tiller—it's

hollow so a wire can be snaked through it to ring a bell (the "horn") on the dash. I had tanks made up for the fuel and engine-cooling water.

Back in 1896 Henry Ford made his one and only Quadricycle and sold it at a profit for \$200.

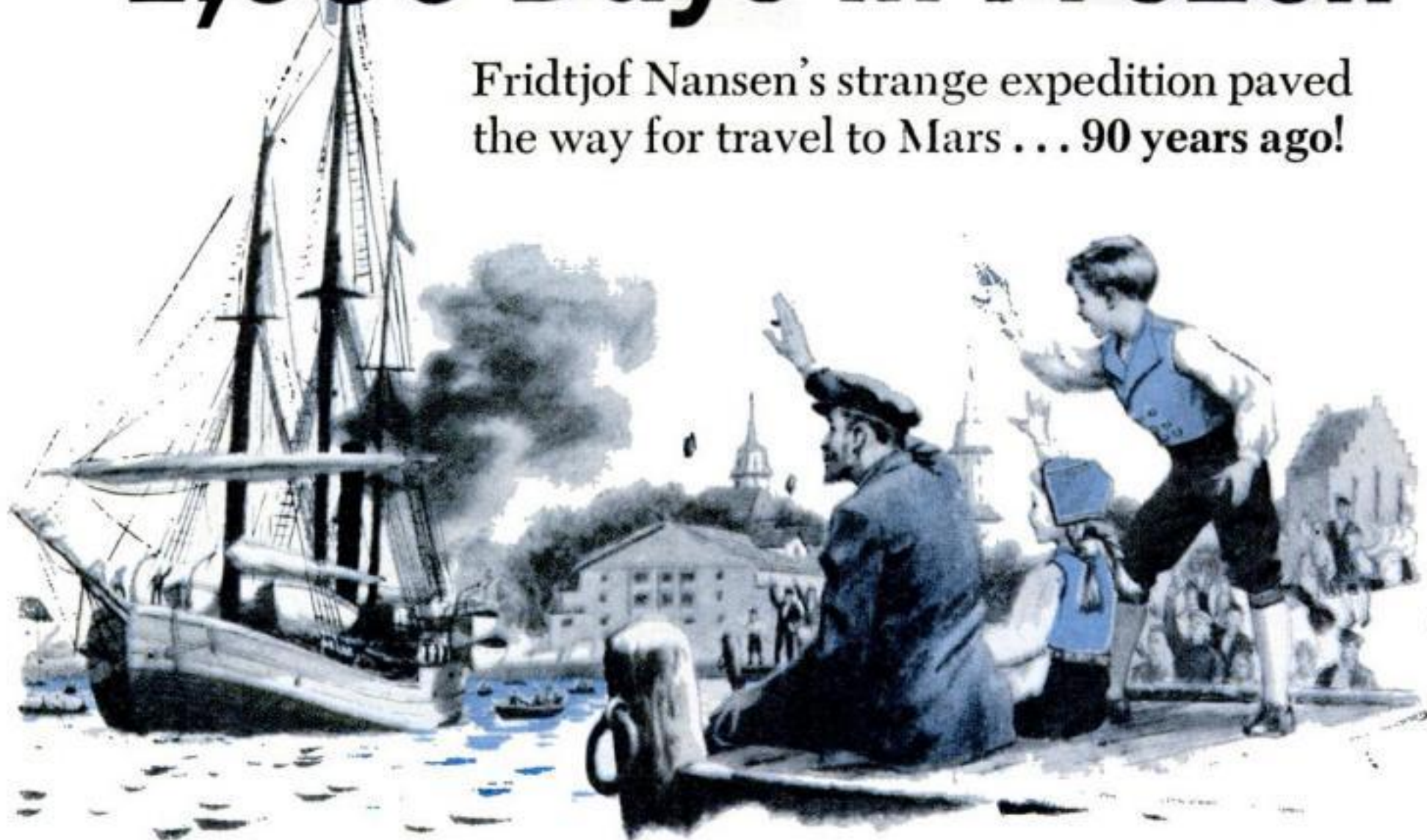
Seems to me, somewhere along the way we've lost Henry's knack. The other night, while my wife wasn't watching, I totted up my money investment in the reproduction—not counting my time and labor. It was more than \$2,000.

But, after all, isn't that just about the price of a 1963 factory-made compact car?



1,000 Days in Frozen

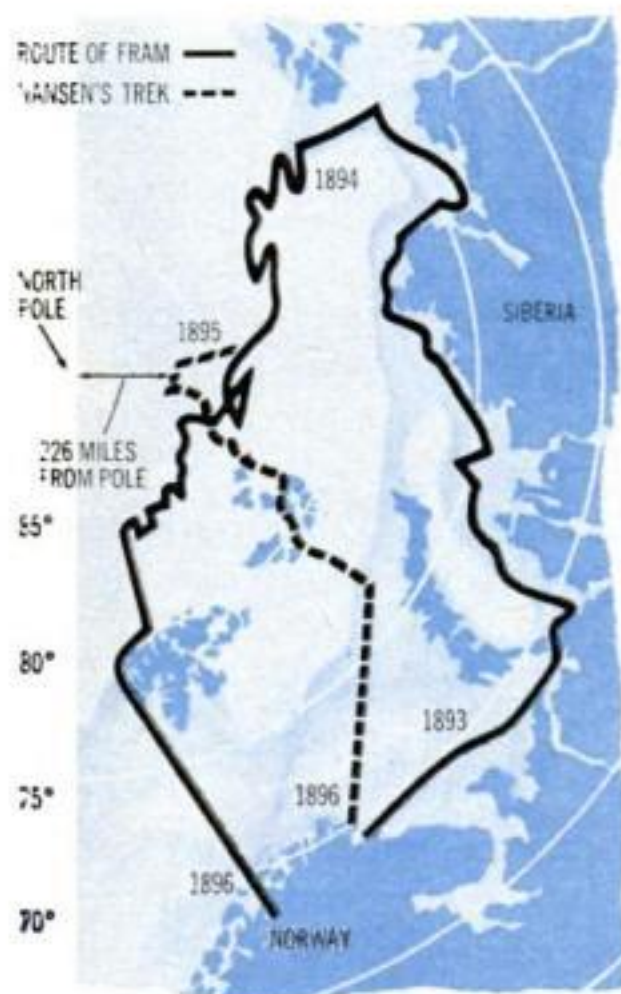
Fridtjof Nansen's strange expedition paved the way for travel to Mars . . . 90 years ago!



1. The start. The pier at Oslo was thunderous with cheers. Nothing like the Fram had ever been seen. She was short (102 feet), snub, powerful, with a four-foot-thick bow. A 220-hp. steam engine could push her 6 m.p.h. Nansen

sailed her east, then north toward ice that blocked the horizon. He knew the ice would squeeze the ship hard, but the hull was dish-shaped. Pressure, he had figured, would not crush it, but merely pop it up on top of the ice.

By E. D. Fales Jr.



Top of the world: Map shows route of Fram in grip of ice pack. Trip time: 1,041 days.

WHEN the day comes for men to blast off for Mars, it won't be the first time the world has worried about explorers far beyond its help. One of history's most worrisome—but least known—voyages began 70 years ago this month. On June 24, 1893, a strange little ship, the Fram, left Norway for the North Pole. Her skipper was Dr. Fridtjof Nansen, 27, a sort of John Glenn of his day.

Then the Fram utterly vanished. Two years passed. Many gave up the Fram and her 13-man crew for lost.

Nansen had sailed with an incredible theory: that ice sheets were like moving turntables. If he could ram his ship onto one, he believed, it would take him where he wanted to go—or at least close to it.

"Madness," said skeptics. A distinguished American explorer called it "senseless self-destruction." Others thought the crew would come to hate each other; or the ice would crush the Fram like an egg.

Today the Fram's story is must reading for astronauts. The men who go to Mars will be cooped up together for 969 days. By coincidence, the Fram was lost to the world for 1,041 days.

'Space'

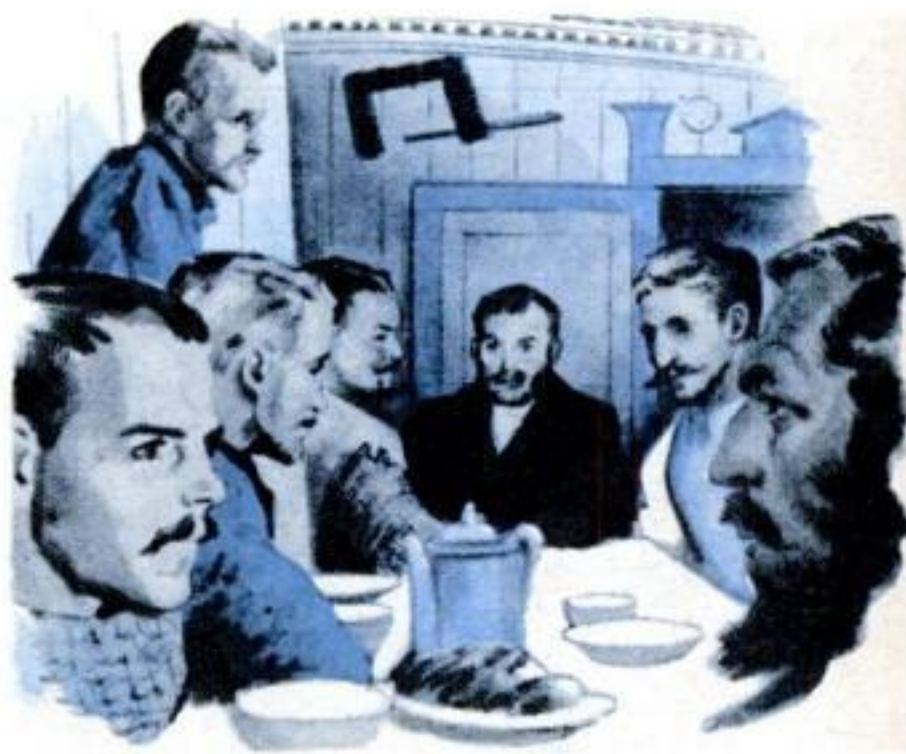


2. The ice attacks. Nansen rammed into the ice, ran out cables. Soon the ship was frozen fast. "It was a dead region," his log notes. But sharp watch was kept for the deadly pressure-ridges, moving walls of ice. On Jan. 27, a distant

roar was heard. A big ridge was moving toward the ship. Great blocks of ice tumbled. That night, the roaring "wave" engulfed the ship, shaking it, threatening to crush it. This was the first of many waves that would batter the ship.



3. The ship fights back. The miracle Nansen looked for occurred. The ship rocked, creaked, and protested but the two-foot-thick oak sides held. He felt the Fram begin to rise. The ice, unable to grip the ship, was pushing the tough little hull safely up on the pack just as he had planned. Nansen still had worries. Drifting ice carried his ship the wrong way. Then it reversed. A year passed; the Fram moved only 250 miles. The crew's patience now faced the crucial test.



4. The nights of "madness." Nansen now watched and waited for fights, for quitters and neurotics. But the men were singing, joking, working. They read, played cards, wrote verse, took notes on the wind, temperature, aurora borealis, ice structure, and animal life. Nansen's careful selection of scientists and seamen was paying off. He'd chosen men of humor and intellect, too absorbed in discovery to be bored or homesick, too full of life to mope.

CONTINUED



5. Nansen leaves. By March, 1895, Nansen's theory was proving out: The ice would carry the Fram within 244 miles of the Pole—closest up to then. Before that, as men will leave a rocket to land (in a smaller ship) on the Moon, Nansen took off by dog sled with a companion, Frederick Johansen, and headed north toward the Pole. He planned to return south by a route farther west. This way, there was a slim chance he might again meet the Fram, borne west by the ice.



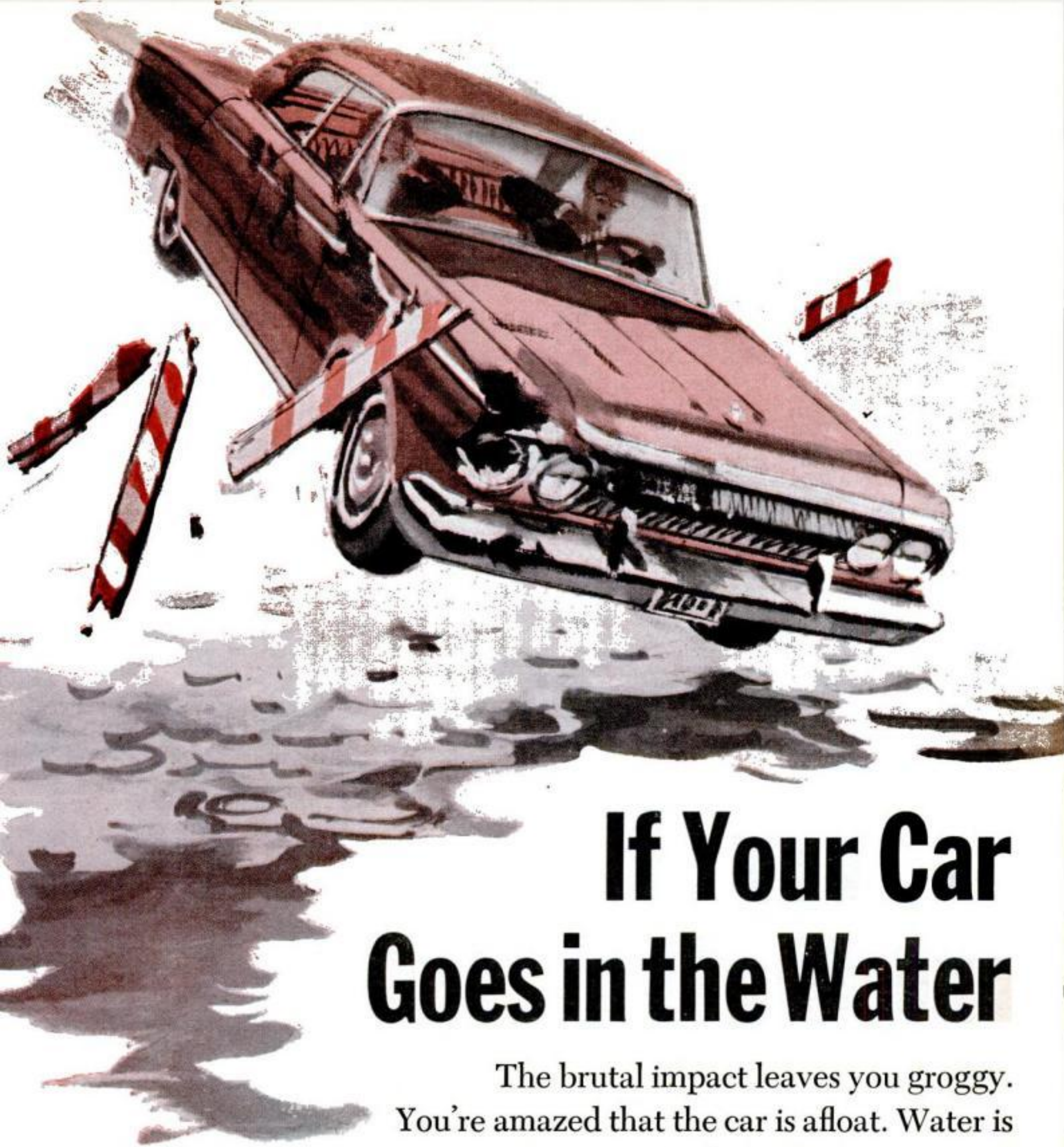
6. White horror. They fought north for a month—until ridge ice blocked them. They shot some dogs to feed others, and pulled side by side in harness, hauling the sleds. Within 226 miles of the Pole—a new record—they turned back, but missed the Fram. Exhausted, with two of 26 dogs left, they were attacked by bears and (while in kayaks) by walrus, and nearly drowned. Finally, in September, 1895, in Franz Josef Land, they dug in for one more winter—their third!



7. The blasting. Meanwhile the "ice turntable" pushed the Fram toward rocky Spitzbergen. Just as skill will be needed to return a space ship to Earth, skill was needed to save the Fram. There were no retrorockets to slow down the deadly push toward land. To loosen the Fram from its prison of ice, the crew set off gunpowder mines. One great blast showered the ship, but cracked the ice beneath it. On Aug. 13, the log entry for the day read: "We are free!"



8. Was Nansen alive? In June, 1896, an English explorer in Franz Josef Land saw a filthy, hollow-eyed, wild man approaching across the snow. It was Nansen. Next came Johansen, his heroic companion. In August an English ship took them home to an astonished Norway. One week later, the incredible Fram returned—its crew in good health. With them came a lesson for today's astronauts: In the long voyages ahead, good men can get along. ■ ■



If Your Car Goes in the Water

The brutal impact leaves you groggy. You're amazed that the car is afloat. Water is pouring over the dash. Can you escape?

By James M. Liston

IF YOUR car skids on a slippery bridge and plunges through the guardrail; if you're hit from behind or sideswiped and your car caroms into a lake—what chance do you have of getting out before you drown?

Or should you bother to worry about it? The likelihood of that happening to

you is pretty slim— isn't it?—and there will always be freak accidents. If that's what you think, then listen to what Corporal William Carter of the Michigan State Police has to say:

"Every accident is a little freakish, and going into the drink isn't uncommon. A blowout at high speed can be just as fatal, but you're more prepared for it. Many drivers have rehearsed what

CONTINUED

45

Cars rumbled down the ramp, leaped from the bank



1 Track of haul-away trailer served as a launching ramp at water's edge. A crane was used

to retrieve cars after they had sunk—or to drop them (tops down) into the water.



3 Impact of dive is taken by front end and windshield. Car submerges almost half its

length. (The study did not include seat belts; they would probably prevent injuries.)

they'd do in such a situation, and they usually react properly: They resist the urge to hit the brake; they avoid oversteering, and get back control.

"But every year about 400 persons die trapped in submerged cars. Many of them are not seriously injured and could escape if they knew how. Or they might be saved if rescuers knew what to do.

"Until recently there wasn't much we could recommend in the way of escape or rescue methods. That was before the pit at Williamston. What we learned there is just a beginning, but it can save lives."

Trooper Carter ought to know. In 1961 he and six other state police scuba divers, working with a research team, spent eight days in a water-filled pit near Williamston, Mich., as driverless cars rolled down a ramp and plunged into 12 feet of water. As soon as a car hit the water, Carter and his fellow divers would start their stop watches, swim alongside, clock the time it took for the car to fill, attempt to open the doors as it sank, observe the air pocket that formed inside, and—while on the bottom—work out possible escape and rescue techniques.

. . . and sank. Results: grim, but not without hope



2 Car leaves ramp at 16 m.p.h. from 56 inches above water. Scuba diver clocks moment of impact and prepares to swim alongside to observe damage and formation of air pocket.



4 Forced out of water by hydrostatic pressure, car bounces back, rear high. Cars entering water on their sides, with windows closed, righted themselves before going to bottom.



5 Critical minutes for escape or rescue are those before the water reaches window level. Cars with windows closed sank slowly—in maximum time of 6 minutes, 3 seconds.

The series of tests on submerged automobiles was conducted by the Michigan State Police under the direction of Commissioner Joseph A. Childs, the American Red Cross, and the University of Indiana. Bernard Kuhn, of the University, served as technical director and based his doctoral thesis on the study.

Four cars were used to gather data: A 1961 four-door Chevrolet, a 1961 two-door Ford, a 1954 four-door Chevrolet station wagon, and a 1953 two-door Rambler. Three other cars were used only for preliminary tests.

Two car haul-aways with tracks served as launching ramps. The tracks of one were 18 inches above water. Clocked by radar, cars left this ramp at 14 m.p.h. Tracks of a second ramp were 56 inches above water and cars left it at 16 m.p.h. Of the 49 tests conducted, 12 were of cars dropped top-down at water level while suspended by a crane.

Each vehicle was tested on its wheels, top, left side, with all windows closed, two front windows open, and left front window open. The station wagon was also tested with the tailgate open and closed. The amount of air retained in the vehicle was measured in cubic feet with a specially constructed meter.

What the tests proved

- When a car hits the water on its wheels, the front end and windshield take the brunt of the impact. The car submerges almost half its length; then, forced by hydrostatic pressure, it bounces back and floats with the engine compartment almost submerged. (The wind-

shields of all cars shattered upon impact when they plunged from the 56-inch ramp at 16 m.p.h.) Cars with all windows closed fill slowly until water begins pouring through the shattered windshield. Then the car sinks rapidly and the angle of descent becomes steeper. When half to three-quarters of the vehicle is under the surface, a suction is created inside the car, caving in the top from two to four inches. As the passenger compartment fills, the remaining air is compressed and forced into the trunk.

When the car reaches the bottom and levels off, the air pocket shifts to the roof of the car. In most instances, air pockets were too small for a person to breathe and survive after the car reached bottom.

- A car with all windows closed will float for a longer time than a car with one or more windows open, thus providing a greater chance of escape or rescue.

- Cars with front engines will descend engine-first at a steep angle. (No rear-engine vehicles were tested.) In water 15 feet or more in depth, the vehicle may end

up after a dive resting on its top.

- Doors cannot be opened until water pressure inside the car is equal to that outside. When the car is completely filled, the doors can be opened—if there is no structural damage.

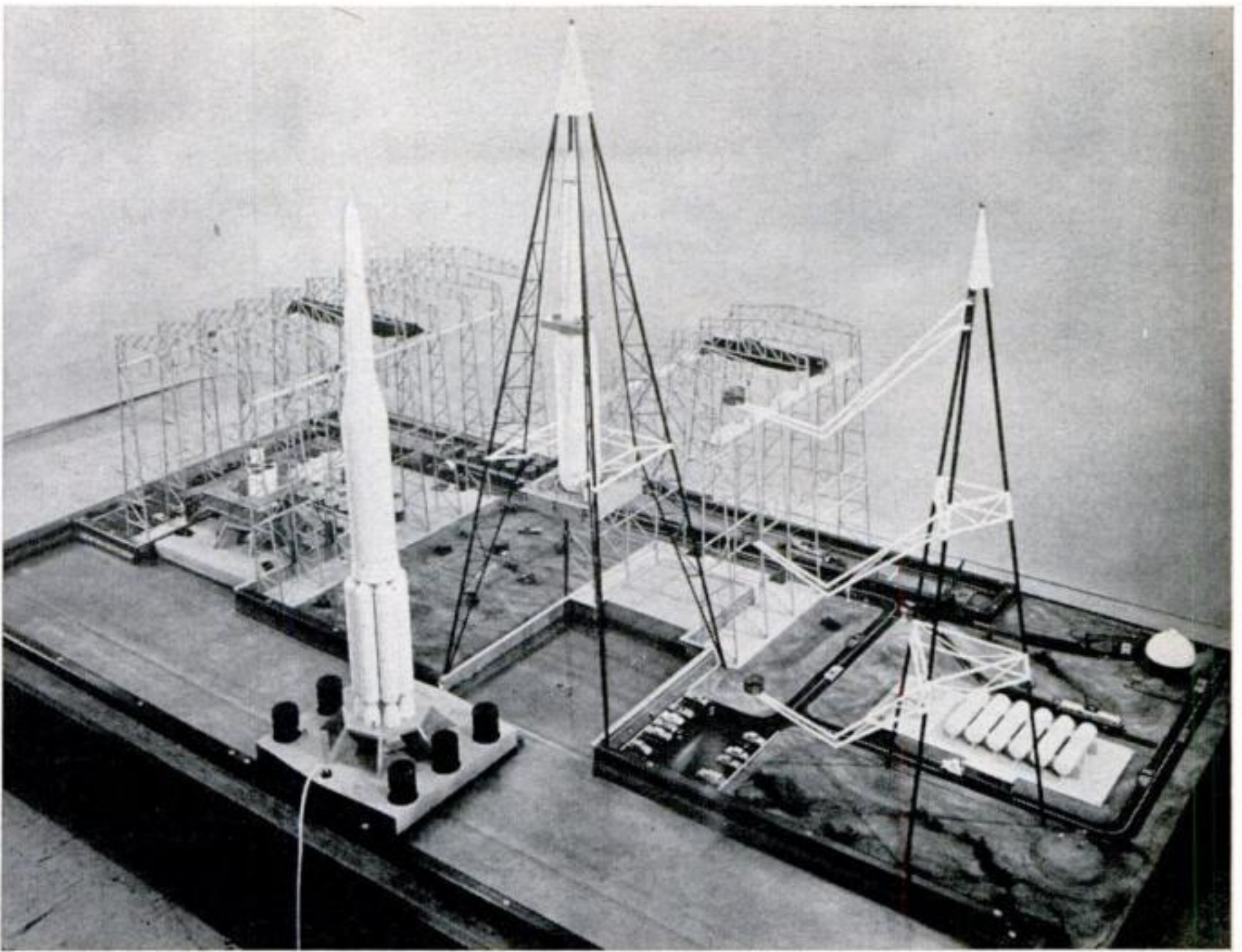
- Cars plunging into the water at 14-16 m.p.h., with all windows closed, submerged in a maximum of 6 minutes, 3 seconds; the station wagon in only 12 seconds. After the wagon's windshield was shattered on impact, the rear door section was forced open by air pressure

[Continued on page 186]

And next winter . . .



"Every winter you read about ice fishermen who lose their cars or are drowned while driving on a frozen lake," says Michigan State Trooper William Carter. "Because they're aware of the danger, many of them make a practice of driving with the door open. In view of what we've learned about car submersions, this may be a mistake. If the ice were to give way, the force of the water rushing through the open door would probably make escape impossible. If the door were closed, the car would remain buoyant long enough for a person to open a window and climb out."



Space-vehicle launch pad would float to site

Floating platforms to carry loads up to 8,000 tons and withstand the blastoff of a missile are now being developed.

Huge space vehicles could be assembled into launching position at a remote location on a platform that would rest on a

canal bottom. Then pumps would build up water pressure under the platform, raising it a few inches so it could be floated to the launching site. The Aeropad, shown above in model form, was designed by Aerojet-General Corp., Sacramento, Calif.

Sun's rays come to aid of stranded motorists

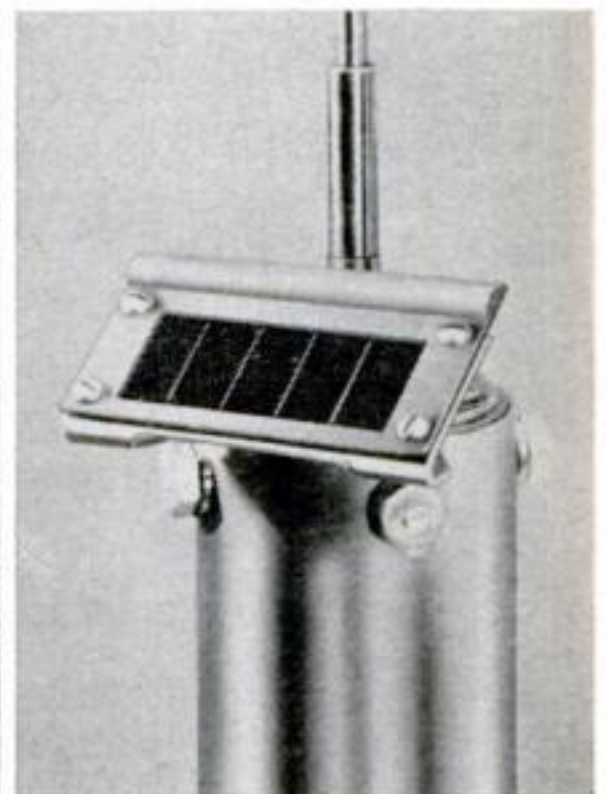
The emergency roadside call box at right is activated by power from the sun.

A motorist in trouble just stops and punches a button. At the Los Angeles police communications room, a panel lights up to show where help is needed. In minutes, a police patrol unit is on the way.

Power to run the radio is supplied from a solar battery developed by Hoffman Electronics. New Jersey has one operated by hand crank.



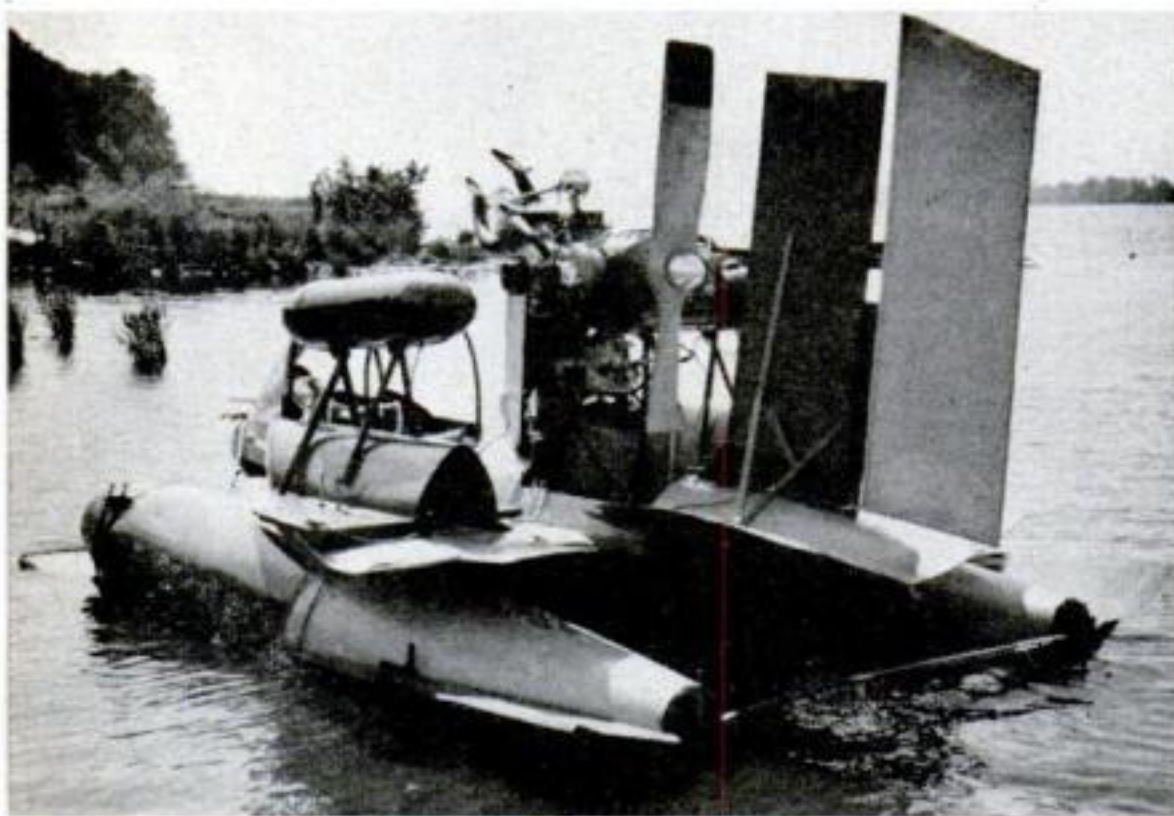
Motorist needing aid simply punches button on call box.



Solar battery on top of pole collects energy from sun.



No-draft speedboat skims over water on wing-tank pontoons resting on 18-foot skis surfaced underneath with aluminum.



Awkward-looking rudders mounted in propeller's slip stream swing to right or left on cable controls and piano hinges.

Air boat speeds over water or snow—and even flies

Called the Hummingbird, the delta-winged speedboat at left lives up to its namesake in activity. It can, says its inventor, skip over the water like a scaled stone, skim over snow two inches deep, and, at high speed, even take briefly to the air.

Windolan Sirmon of Springfield, Va., used surplus Air Force wing tanks as pontoons, bomb casings as overhead fuel tanks. A pusher propeller, spun by an 85-hp. Ford engine, moves the craft at 80 m.p.h. over water, Sirmon says; at speeds over 55, it will fly briefly, 15 feet high. With a 180-hp. engine, he expects to make 100 m.p.h.

Air rudders behind the prop and stub delta wings at rear of pontoons are controlled from the cockpit.



Cockpit simulator rides aerial tramway under translucent ceiling giving day or night view.



Fog pours in around "cockpit" from which jet pilots study visibility of landing lights below.

Fog chamber tests landing lights

A 30-by-800-foot building at the University of California's Richmond Field Station tests the value of fog lights proposed for airport runways. Lights under test are installed along the floor in various patterns

and spacings, and at different intensities. The chamber is then filled with artificial fog. Airline jet pilots climb aboard a wingless cockpit and are pulled along an overhead tramway so they can judge the effects. The fog-light study is sponsored by the Federal Aviation Agency.

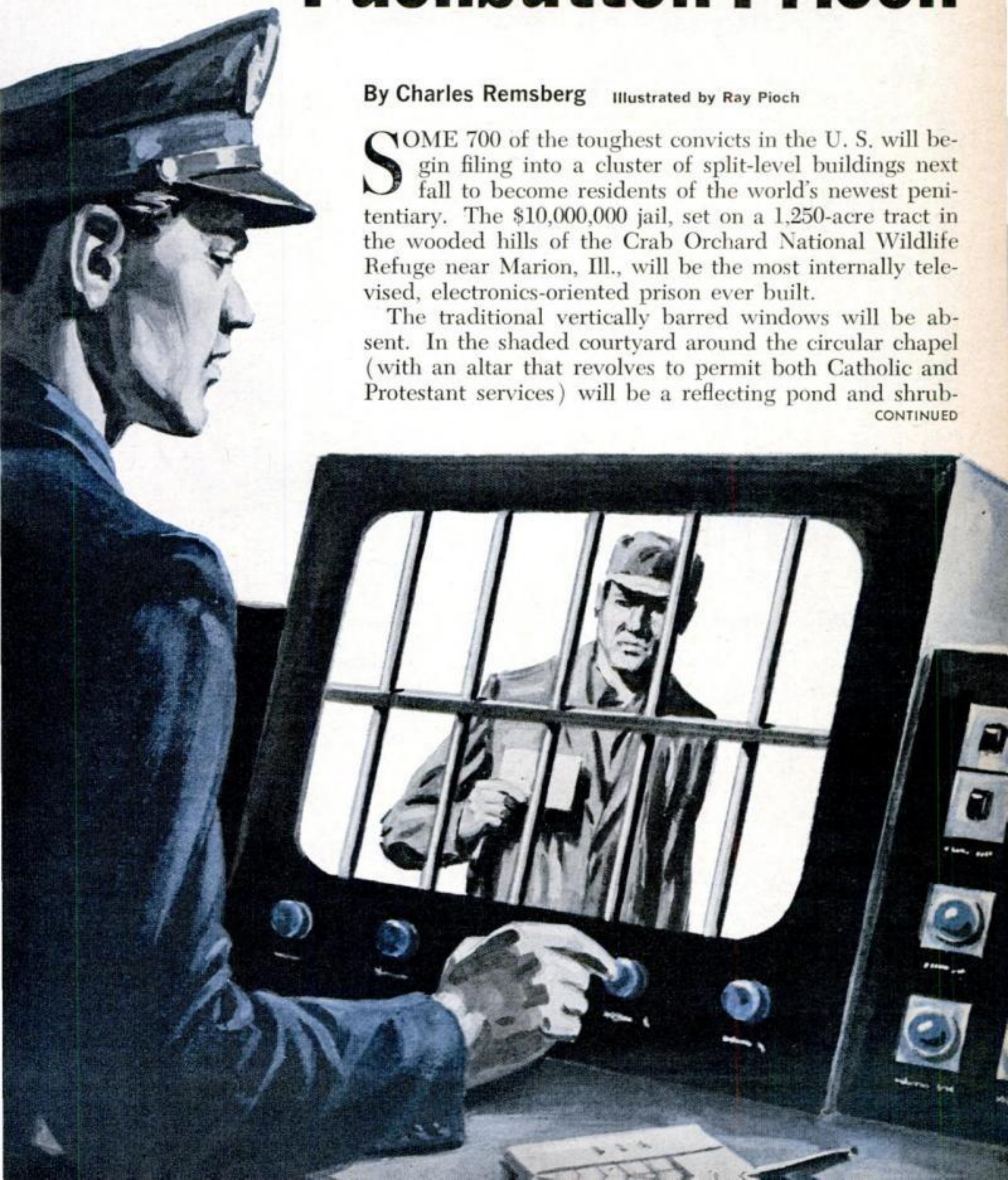
Inside the World's First Pushbutton Prison

By Charles Remsberg Illustrated by Ray Ploch

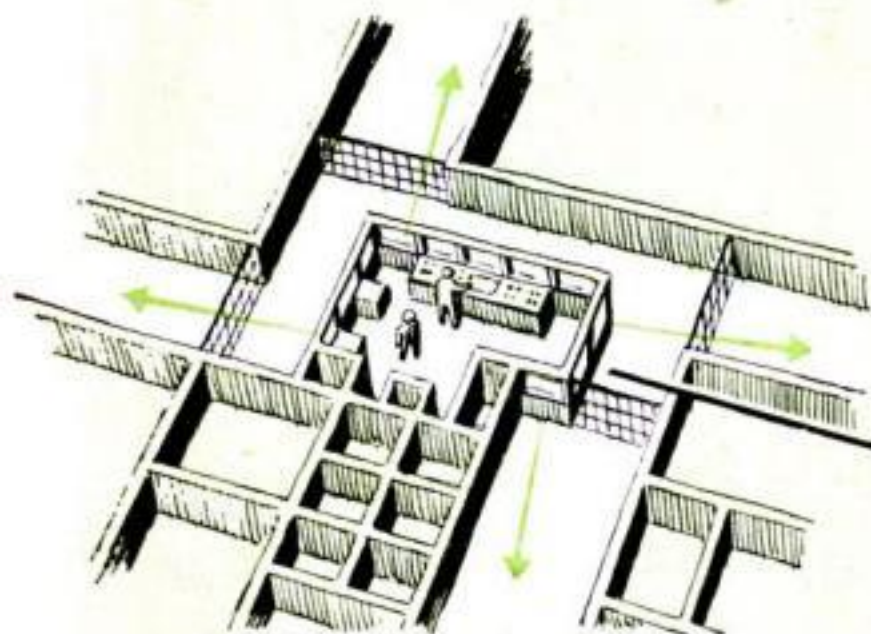
SOME 700 of the toughest convicts in the U. S. will begin filing into a cluster of split-level buildings next fall to become residents of the world's newest penitentiary. The \$10,000,000 jail, set on a 1,250-acre tract in the wooded hills of the Crab Orchard National Wildlife Refuge near Marion, Ill., will be the most internally televised, electronics-oriented prison ever built.

The traditional vertically barred windows will be absent. In the shaded courtyard around the circular chapel (with an altar that revolves to permit both Catholic and Protestant services) will be a reflecting pond and shrub-

CONTINUED



Maximum surveillance is a built-in feature of the Marion penitentiary's pinwheel design, shown in the artist's drawing at right



CONTROL CENTER

Here, at hub of pinwheel layout, guards can see the full length of all four corridors and continuously keep an eye on inmates going from any wing to another.



REMOTE-CONTROL GRILLE DOORS

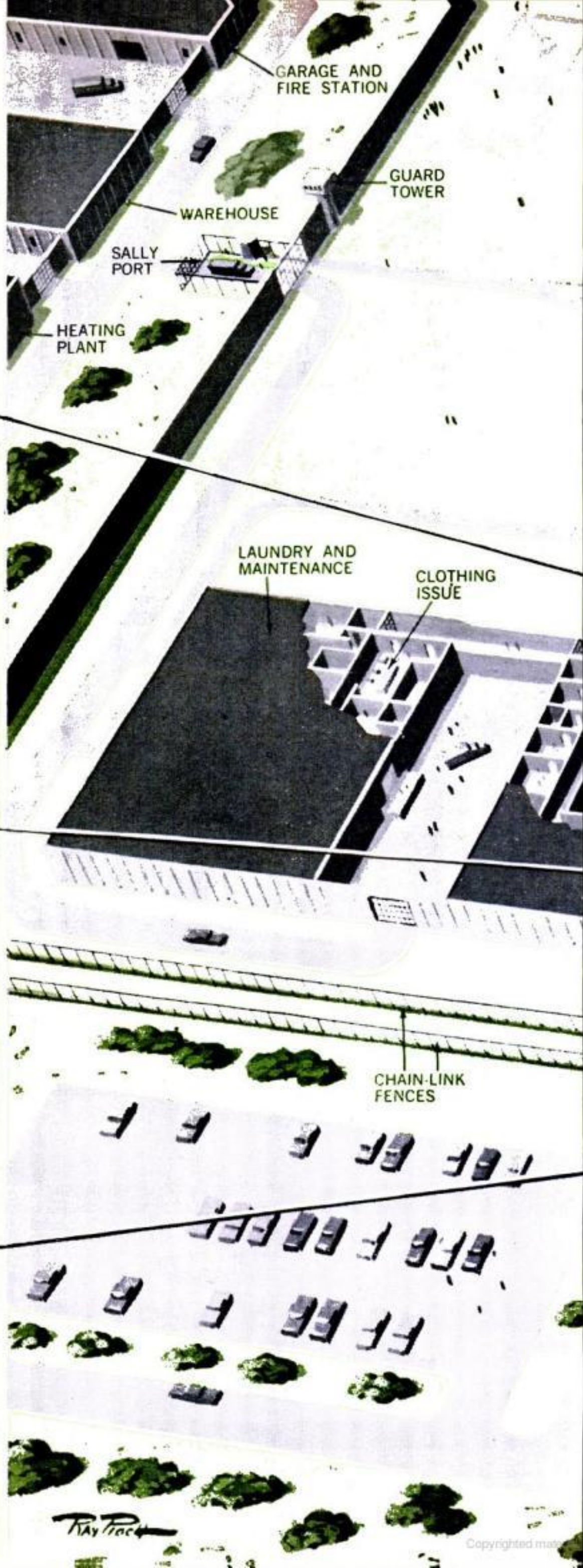
At these doors in corridors connecting control center with visitors' rooms, prisoner must identify himself by showing pass to TV camera, speaking into microphone.

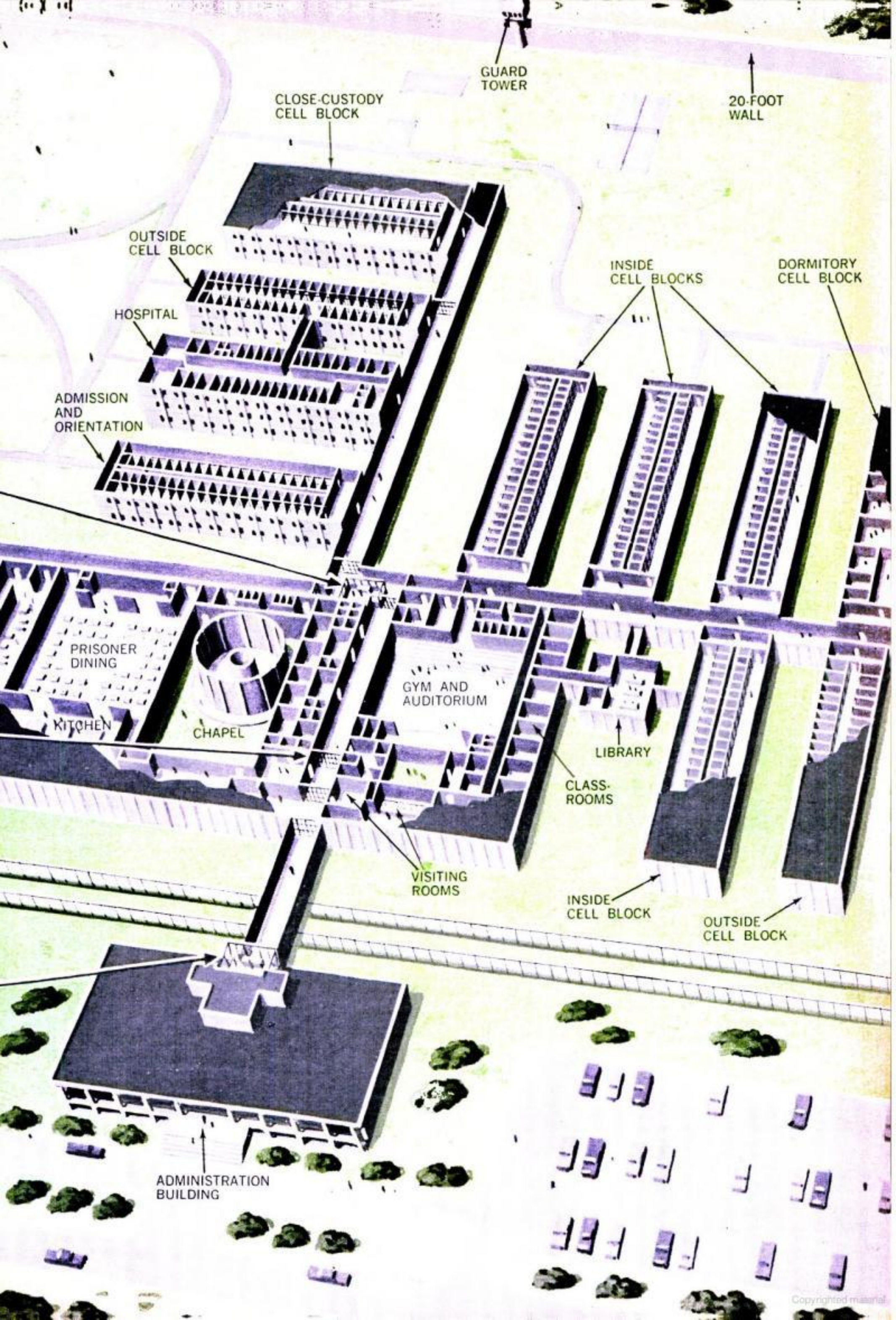


MESSAGE CENTER

On TV screen, guard checks prisoner's pass against index file. If errand is legitimate, guard presses button to open door electrically and let prisoner through.

CONTINUED





GUARD
TOWER

20-FOOT
WALL

CLOSE-CUSTODY
CELL BLOCK

OUTSIDE
CELL BLOCK

HOSPITAL

ADMISSION
AND
ORIENTATION

INSIDE
CELL BLOCKS

DORMITORY
CELL BLOCK

PRISONER
DINING

KITCHEN

CHAPEL

GYM AND
AUDITORIUM

LIBRARY

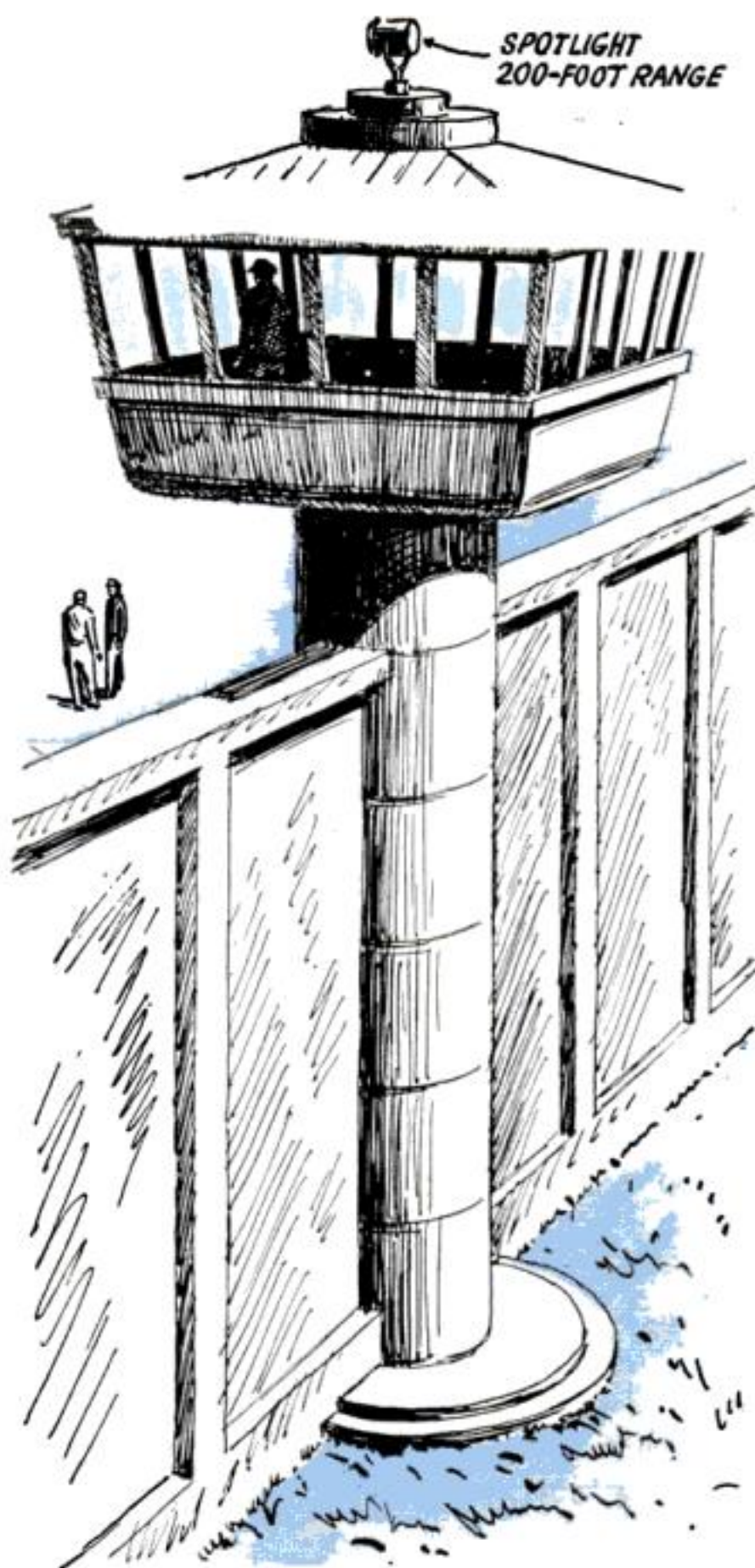
CLASS-
ROOMS

VISITING
ROOMS

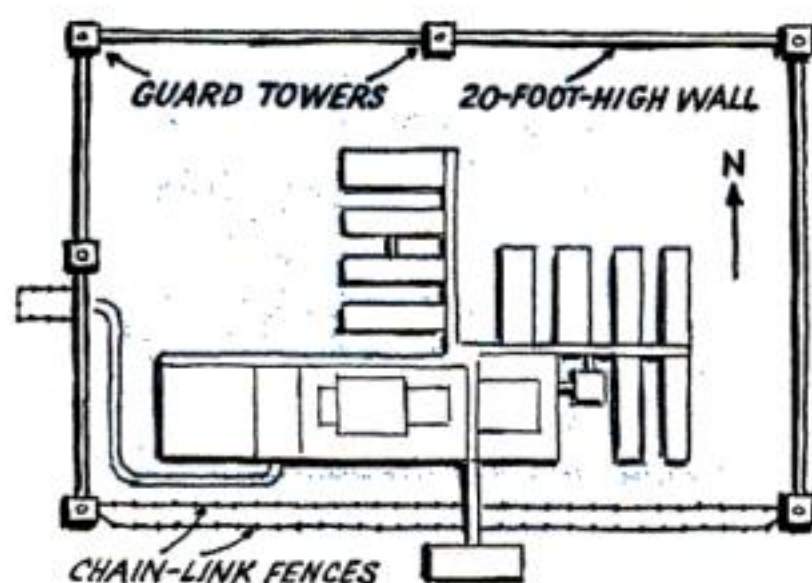
INSIDE
CELL BLOCK

OUTSIDE
CELL BLOCK

ADMINISTRATION
BUILDING



Six guard towers, 35 feet high, are located atop outside walls. They are connected by intercom to both control and message centers.



Plan view shows the placement of walls, double-link chain fence, and guard towers in relation to various penitentiary buildings. These all interlock for maximum exterior security.

bery. Opening off the library will be two secluded patios for reading and relaxation.

But the open appearance will be deceptive.

More than brick and steel. U. S. Bureau of Prisons officials are depending on science to make Marion the world's hardest place to get out of.

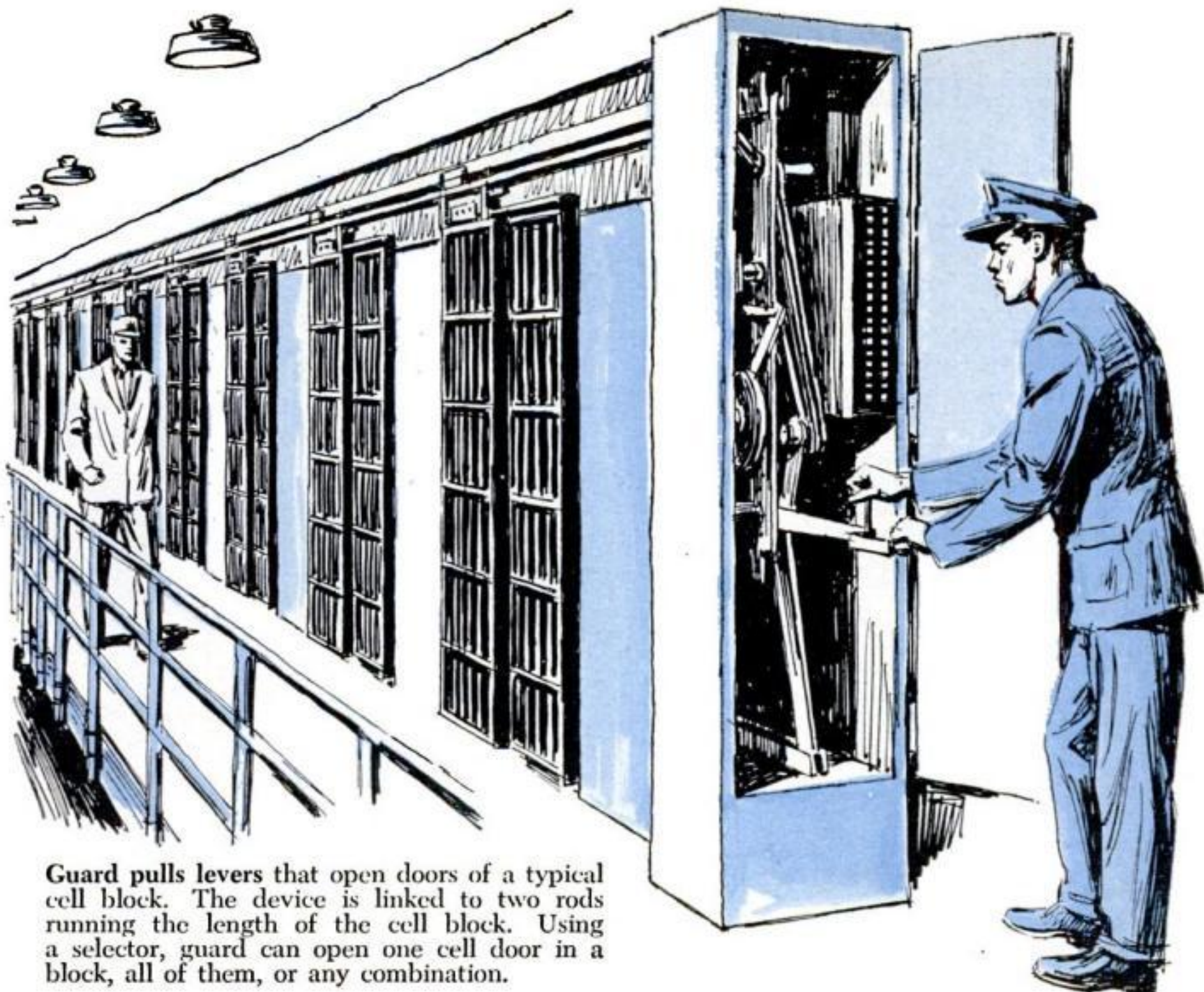
Designed by St. Louis Architects Hellmuth, Obata and Kassabaum with security foremost in mind, Marion's 15 main buildings are arranged along four corridors that radiate from a central core. Each corridor runs midway between the floors of the two-story buildings, allowing easy access to either level—and making Marion the first split-level prison. Any part of this complex can be reached without stepping outdoors, but anyone going from one wing to another must pass through the hub of the corridors.

This pinwheel plan makes surveillance easy. Guards standing behind plate-glass windows in the bulletproof control center at the hub can scan the full length of each hallway by moving only a few inches. Other guards, manning a glass-enclosed message center atop the prison's administration building, can keep a similar close tab over the roof tops.

The control and message rooms, in fact, will be the nerve centers of the entire penitentiary. Like airport control towers, they will monitor and direct the bulk of the institution's traffic, utilizing 15 separate communications systems.

The centers will duplicate each other in much of the equipment that will stud their 32-conduit consoles. Thus, in an emergency, one could do the assigned tasks of both. If the control center were "lost" during a riot, for example, the message center could still maintain contact with almost every inch of the prison. As an added security precaution, the corridor between the two centers will be sectioned by four automatically operated, heavy steel grille doors.

At each of the barred doors along the corridor leading from the prison entrance in the administration building to the visiting rooms and the heart of the insti-



Guard pulls levers that open doors of a typical cell block. The device is linked to two rods running the length of the cell block. Using a selector, guard can open one cell door in a block, all of them, or any combination.

tution, will be two closed-circuit TV cameras.

When a prisoner wishes to pass through a door, he'll speak to the control or message center through an intercom installed near the grille. The ceiling-mounted cameras will be activated, flashing his picture to the center's monitor and also revealing the hallway near the doors so that guards can be sure he's alone.

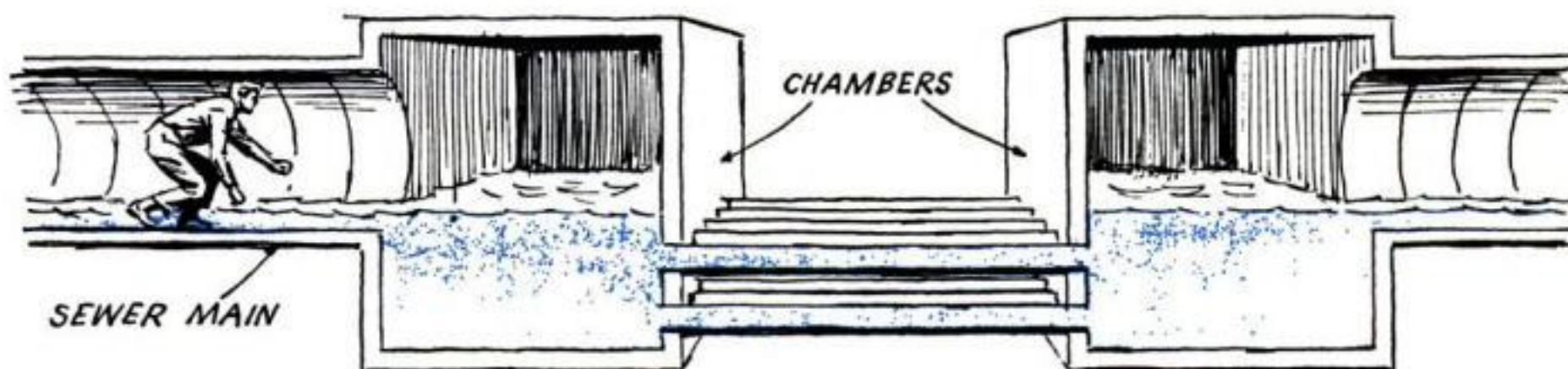
The convict will hold his pass up to the camera, and his name will be checked

on a rotary index file which will list his security status and the areas that are off limits to him. If he checks out okay, the door will be opened, electrically.

Eventually, the prison's closed-circuit TV will be expanded to peer over the 72-man cell blocks and the visiting rooms. Until then, on-the-spot guards will perform these chores.

Listening in. Highly sensitive microphone-speaker units will listen for trouble

[Continued on page 167]



No escape through sewers: Four-foot main empties into a chamber. Sewage continues from

there through escape-blocking eight-inch pipes to another chamber, then back to a main.

Seeing double? Which No. 3 went 164 m.p.h.?

These two 1963 Chevrolets look like twins, but they're anything but identical. Set up for racing by Ray Fox of Daytona Beach, both are driven by Junior Johnson (shown, left, with Fox). But while Fox prepared the car on the left for super speedways like Daytona and Atlanta, he set up its stablemate for dirt tracks.

Both cars have 427-inch engines, quad carbs, and three-speed manual gearboxes. The paved-track car was tuned to nth degree. The dirt-track car was actually detuned; too much power is a handicap on soft surfaces. Dirt tracks require heavier frame gussets and steering linkage, stiffer springs and shocks. A special radiator on



the paved-track car has fins spaced 12 to the inch (factory spacing, 14). The dirt-track car has only 8 per inch, so dirt from



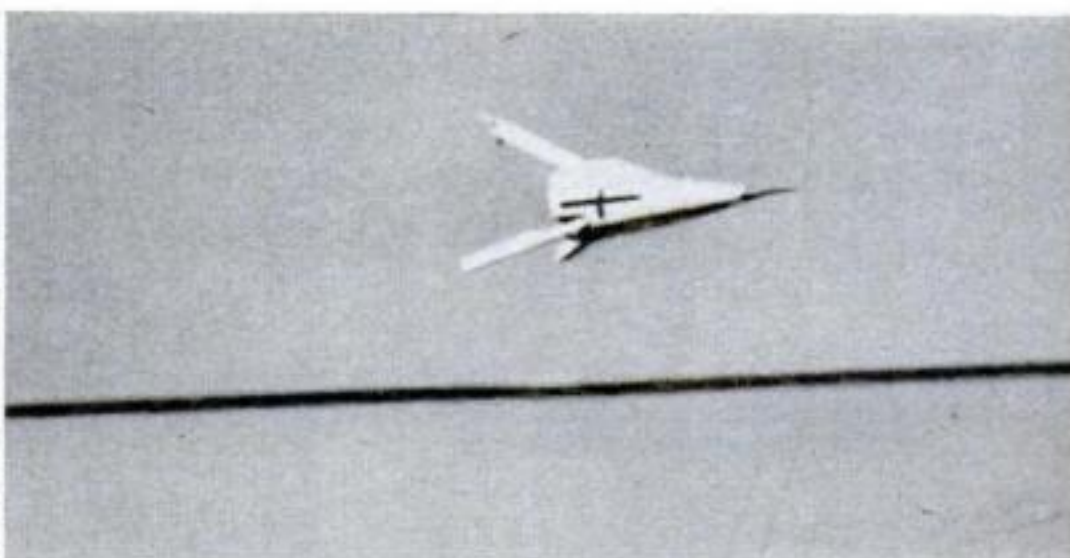
42-m.p.h. landing craft

The Navy has pulled the wraps off a new hydrofoil landing craft that can do better than 42 m.p.h.—three times the speed of its famed World War II forerunner, the LCPV (H).

The 40-foot boat rides on retractable hydrofoils and is powered by two 275-hp. Chrysler engines. Controls are hydraulically operated.



1. Ejection seat leaves rocket sled.



2. Fins out, it goes into free flight.

Escape capsule for supersonic jets passes high-speed test

This new supersonic ejection seat is the pressurized nose of the plane itself. It's intended for use in abandoning a craft

traveling 2,500 m.p.h. at thin-air, freezing altitudes of 100,000 feet. The Lockheed-developed capsule was successfully tested



PHOTO BY TAYLOR WARREN

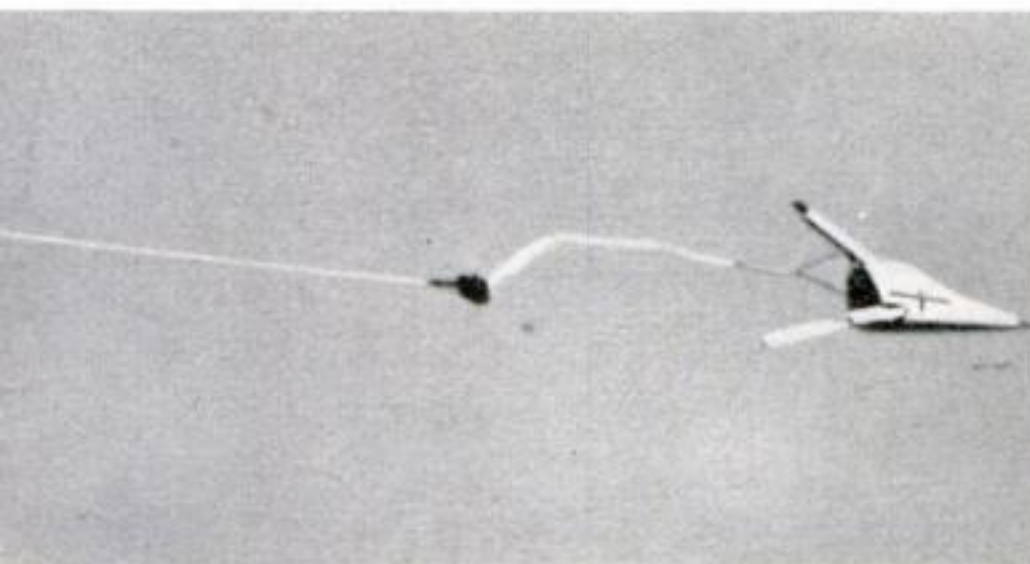
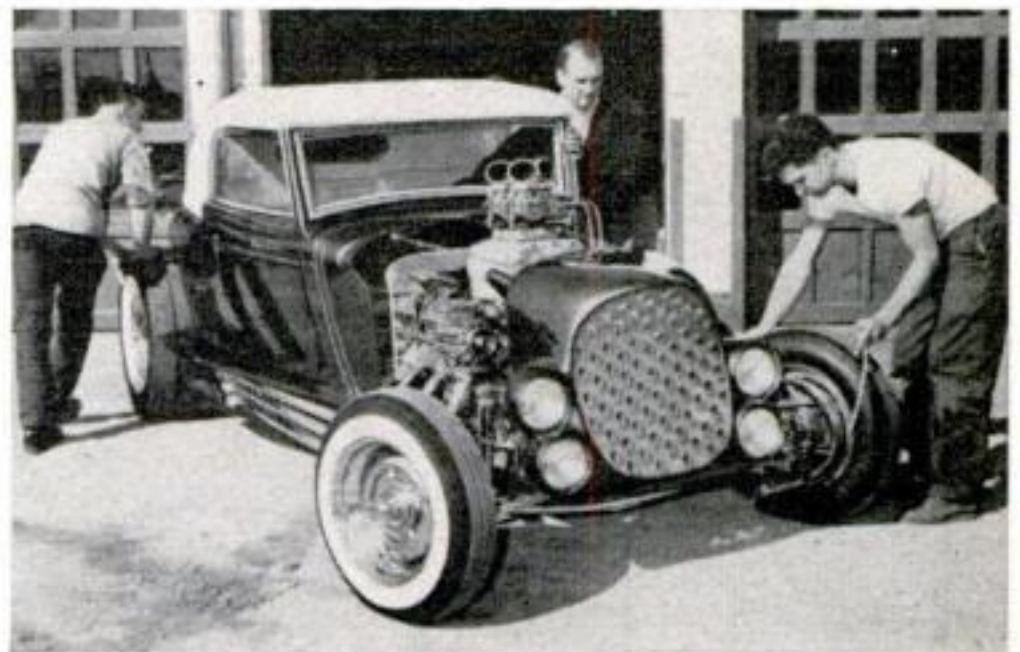
the track goes through instead of clogging. Johnson averaged 164.083 m.p.h. in car at left to win a 100-miler at Daytona. Eight

days later, in car at right, he set a new qualifying record on the Spartanburg (S.C.) dirt track. Speed: 64.47 m.p.h.

This rod doesn't drag

It has 400 hp. on tap, but owner Don Vargo of Melvindale, Mich., has never raced his 1934 Ford hot rod. Valued at \$7,000, it's only for show.

Vargo installed an Olds V-8 engine and equipped the car with four carburetors and a supercharger. Body work, including channeling (lowering the body over the frame rails), a handmade front end, and painting (red), was done by the Alexander brothers' custom shop in Detroit.



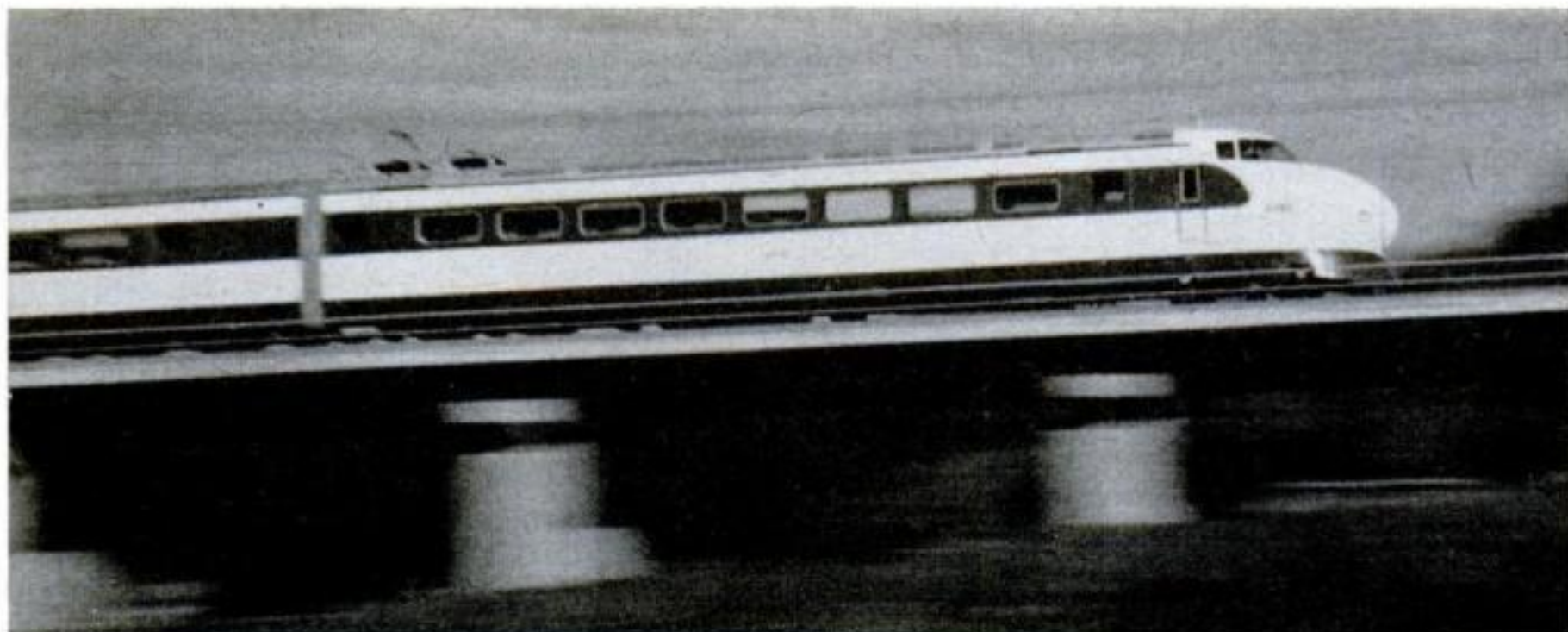
3. Five-foot drogue parachute is released.

on a rocket sled at Edwards Air Force Base in California, reaching a speed of 250 m.p.h. in its first trial. Further tests are planned at 1,000 m.p.h., where maximum drag occurs. Once free of the fuselage, the



4. Big 72-foot recovery chute opens.

nose capsule releases three guidance fins, followed by two parachutes to let it down gently. It's airtight and is designed to float on the water should the pilot be forced to bail out at sea.

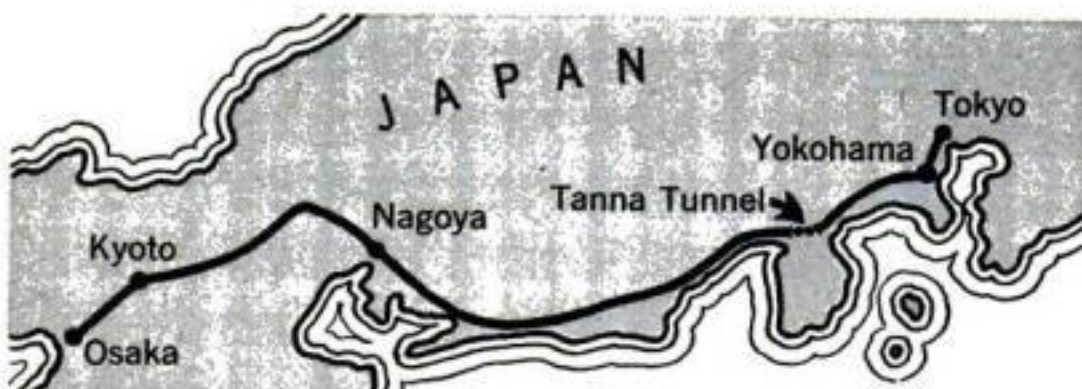


New Tokyo-Osaka superspeed electric train whooshes over trestle to set record on trial run.

Japanese express hits 151 m.p.h.

On a section of the Tokaido line of the Japan National Railway between Tokyo and Osaka, an electric super-express has reached 151.88 m.p.h. on a test—and held that speed for a full minute.

The train is streamlined like an airplane, its center of gravity is low, and light metals and plastics in its body shell and interior cut weight. The track is being completely relaid, with curves smoothed out or eliminated altogether. When the train goes into operation next year, the 320-mile run will take three hours at regular speeds of 138 m.p.h. and bursts up to 156 m.p.h.



Relaid route will help cut express travel time in half.



Electric rails and concrete ties are installed. Roadbed for entire 320 miles has been hardened with concrete.



Big trailer uses both push and pull

A giant trailer that can handle 275-ton loads transports heavy equipment to a new Arizona Public Service plant being built on

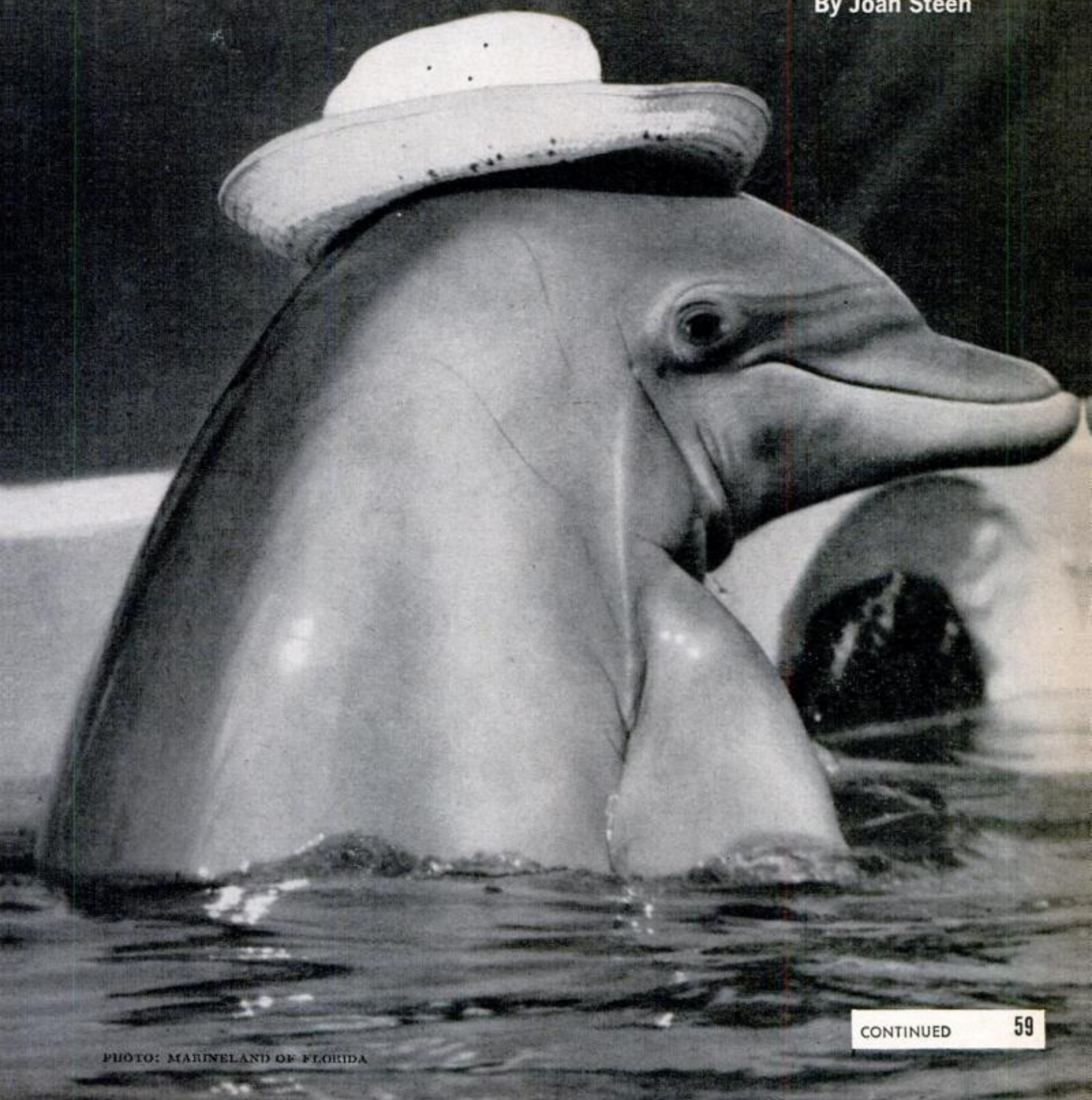
the desert. The \$110,000, 84½-foot-long vehicle is moved by two power units: a 430-hp. tractor in front, a 600-hp. dozer behind. The passenger car alongside gives an idea of the trailer's size.

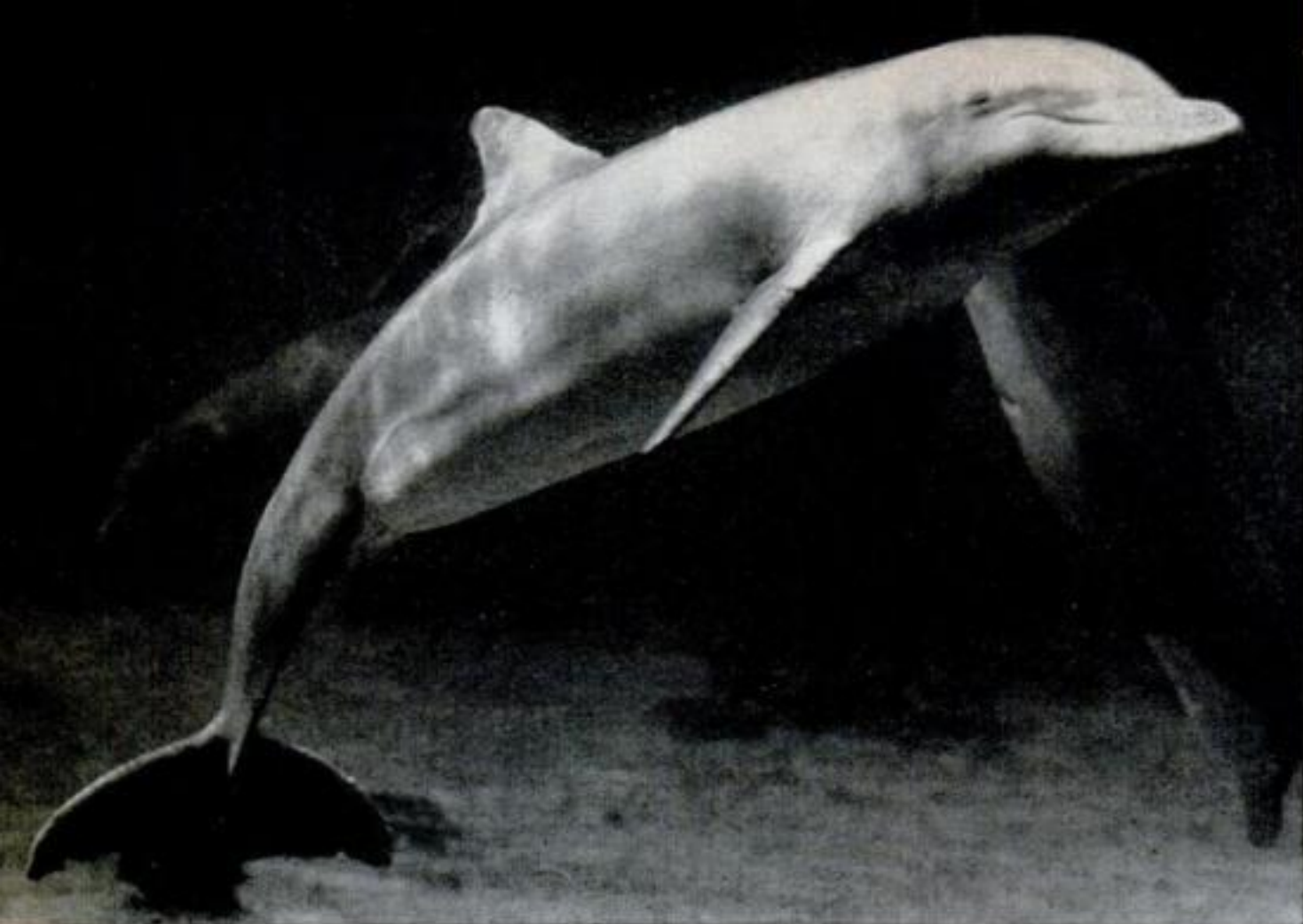
PORPOISES

...Smarter Than People?

Maybe not. But even skeptics agree that these aquanauts who left dry land millions of years ago to explore the sea now seem to enjoy the best of both worlds

By Joan Steen





"Gallop" porpoise moves through water, powered by up-and-down motion of his tail. Front flippers (once arms and hands), are used for steering and balance; back fin for balance only. Skin is smooth, flexible, and pressure-sensitive, permitting porpoises to swim at high speeds by assuming almost drag-free contours.

COULD a porpoise track a nose cone? Could it be trained to explode a mine like an undersea commando, or dive-bomb a sub like a Kamikaze? And—the \$64 question—could it learn to communicate with man?

Neurophysiologist John C. Lilly of Miami thinks it could, and the National Aeronautics and Space Administration is backing his research. NASA reasons that if man could learn to talk to porpoises (or vice-versa), then astronauts might learn how to communicate with non-earthlings—should the need arise.

The logic is sound enough, granted that porpoises are that bright. But are they? Dr. Lilly thinks so. Other scientists disagree—with the result that porpoise research, scarcely 10 years old, is livelier than ever.

Aeronautics specialists, hydrodynamicists, engineers, and physicists have jumped in, adding fuel to the debate. But before you decide whether man risks any rivalry from animal intellect, a little background information may help.

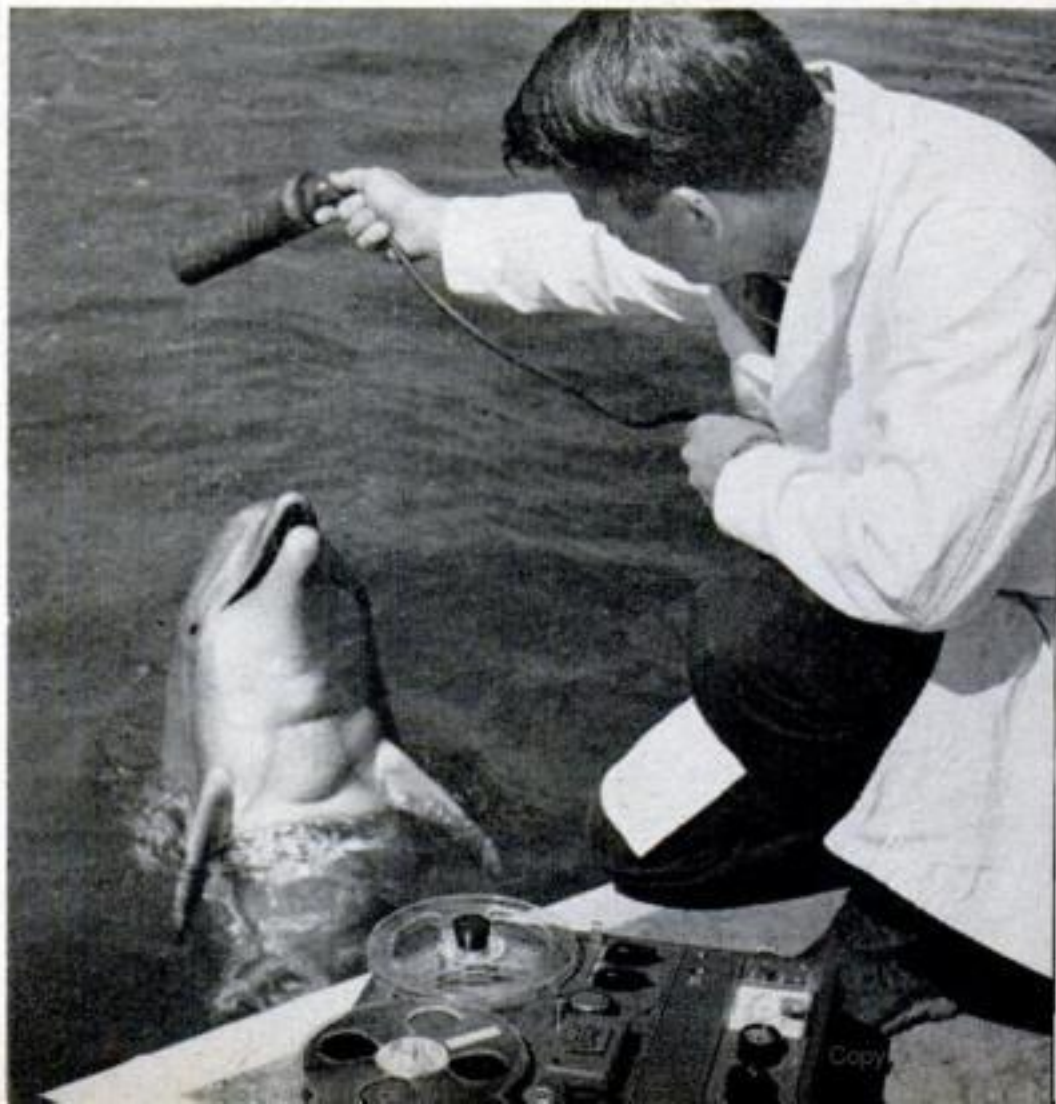
Porpoises, and their dolphin relatives, are small (300-pound) toothed whales—sea-going mammals. (Technically, porpoises' teeth are shaped like garden spades, and dolphins' are pointed, but the names are often used interchangeably, especially in the U.S.)

In a sense, porpoises earned an early

place in the space program. They were the first four-footed animals to leave solid earth to return to the sea, which had become a hostile environment for animals long used to living on dry land.

But they didn't go whole-hog. In adapting to the radically different and weightless world of water, they hung on to some of their best land talents. That's no mean feat, as any engineer or biologist can report. What it means in terms of porpoise mental prowess will come

And now a few words from "Splash"—a bottle-nosed dolphin at Marineland of the Pacific. Researchers believe "whistles" are porpoise language, while "clicks" are their sonar signals.



later. Right now, look at the effect on their engineering capability:

Porpoises outswim many fish. At full throttle they can top 30 knots. How a half-horsepower animal moving through a medium as dense as water could do this was a mystery solved by Dr. Max O. Kramer, a German aeronautics expert. Studying the skin of the porpoise, he discovered a thin layer of water-logged spongy ducts under the surface. As the porpoise swims, these ducts take up the point-by-point pressures of wave motion and turbulence, giving the sleek body a near-perfect drag-free contour. "The porpoise," Dr. Kramer comments, "has solved the problem of laminar flow." This is something that aircraft engineers are still working on. [See PS, April, page 96.]

Porpoises outleap fish. And dive, too. Anyone who's watched them perform at places like Marineland of Florida near St. Augustine, at Miami's Seaquarium, or at Marineland of the Pacific at Palos Verdes Estates, Calif., knows that these aquanauts can leap through hoops 10 feet in the air or execute neat surface dives and disappear.

Fish go up and down, too. But they swim on "floors" of the sea most of the time, wagging their tails (and backbones) from side to side.

Unlike fish, the porpoise's tail flukes—and his driving power—are horizontally opposed to his body. He swims by pushing his flukes up and down—executing a kind of land-gallop in water. Give an extra burst of energy to that motion and the porpoise can zoom up out of the water like a rocket, or crash-dive like a sub.

The porpoise can stay down, too, holding his breath for as long as 10 minutes if necessary—something no human skin-diver can match. Not only can the porpoise take in more air, but he can also extract the oxygen from it more efficiently, and store more of it in his muscles. His heart-beat slows down when he is diving, too.

Porpoises have another unique aquatic talent: They can ride the bow waves of boats. How they do this stirred almost



Porpoise soars through the air with the greatest of ease at Miami's Seaquarium. Rocketlike thrust comes from motion of tail muscles. Tail is also a powerful weapon in shark combat.

CONTINUED



Closing the net's loop around the porpoise was the ticklish last step in the pursuit.

How to catch a porpoise—in two difficult lessons

The sky was blue-gold, the sea calm, and the lab quiet—until a man appeared with the news: A porpoise had been spotted swimming off a private estate. The “lab” was the Lerner Marine Laboratory, a field station of the American Museum of Natural History on Bimini in the Bahamas. Here was a chance to capture an expensive research animal, the scientists thought.

Dr. Robert Mathewson, the lab’s stocky, articulate director, launched the campaign. “We’ll need the big nets,” he called to the native staff in their blue uniforms.

He might well have said “all the nets.” The porpoise was swimming in a dock-and-lagoon maze of mangrove swamp and palm islands threaded with channels that led back to the sea. All would have to be sealed off.

For the next few hours it was “hide-and-seek,” played with an animal that could do both very well. The porpoise—a female bottle-nosed dolphin—would surface, eye her pursuers, then dive to elude them. She used her sonar to detect nets and ducked under any not properly weighted.

as big a controversy as the current intelligence debate.

Hydrodynamics at work. Finally, Andrew A. Fejer and Richard H. Backus of the Woods Hole Oceanographic Institution came up with the ingenious explanation: The porpoise doesn’t ride any *visible* bow wave at all. What happens is that the ship’s bow creates an invisible pressure field as it pushes forward in the water. The field stretches out in front and down along the stem of the vessel. Porpoises, feeling this field, can and do stack themselves in underwater layers in front of the boat—happily blown along like leaves in a breeze.

So much for porpoise hydrodynamics. Their audio-video engineering is equally showy. Again it reflects the redesign of

equipment formerly adapted for air use.

Consider what that means in terms of sound. Sound travels close to five times faster in water. It is absorbed less. Its pressure is 60 times greater. Finally, there is no “mismatch.” The sound-conducting properties of water equal those of animal tissue. That means that nearly all the sound gets through. (In air, 99.9 percent of the sound energy striking your ears is lost by reflection.)

Clearly the first porpoise aquanauts must have suffered punctured eardrums! Yet these difficulties were overcome—in a spectacular way. For today, a porpoise’s hearing is better than any other living creature’s except the bat’s.

And, like the bat, the porpoise uses its hearing to navigate in the dark or in



Once beached, the lady lay calm. I stooped to pet her silk-smooth skin.

"Hmmm," said porpoise-expert Margaret Tavolga, "all she has to do is figure out she can jump over the nets"—news that cheered no one.

As night fell, casualties mounted. One scientist was shivering as a result of a dive to secure a net. The net-storage reel had collapsed from overstrain. All of us itched from the vicious assaults of the sand flies. Dr. Mathewson decided to call it a day.

Round Two began at low tide the next morning. The plan was to get the porpoise into a corner and then bag her. It worked. As Dr. Mathewson, in one skiff, blocked an escapeway, John Arnold, an octopus



Bedded on foam rubber, she began the delicate journey back to the lab.

authority from the University of Minnesota, and Bruce Rolle, the lab carpenter, circled in their canoe, leading around a net-casting skiff. Then one researcher jumped in to bring the net back to land.

Next Pedro Romer, the lab's Chief Collector, supervised lifting of the porpoise to shore. She lay there strangely calm as we petted her and doused her with water to protect her from sunburn.

But there was no danger of that: Less than 20 minutes later she was swimming in one of the lab's pens and—from the sound of it—giving her version of the Great Porpoise Pursuit to her playmates.

murky water by sonar. It transmits sound pulses and listens for the echoes when they bounce off objects.

Striking confirmation of this skill has come from the experiments of Dr. Winthrop N. Kellogg of Florida State University, Dr. William Schevill of Woods Hole, and others. They recorded the "rusty-hinge" and occasional canary-whistle sounds of the bottle-nosed dolphin and found them to be complex pulses of audible and ultrasonic sounds. The frequencies may vary from 3,000 to almost 200,000 cycles per second, and the transmission rate from a few times to over a hundred pulses a second.

So fine is this echo-ranging that Dr. Kellogg's tests show that a porpoise will respond to half-a-spoonful of water

dropped into its pool. can distinguish between good- and bad-eating fish, and can swim an obstacle course through a network of metal rods at night.

Sonic puzzle. How the porpoise produces its signals is a mystery. It has no vocal cords. The evidence now points to a series of muscles and air pockets that lie along the nasal passage from the blowhole to the lungs. The porpoise may be able to vibrate these muscles or control the air flow to produce sounds.

Interestingly enough, porpoise hearing and speech were readapted for use in water, but they still work in air.

So does the porpoise's eyesight. A trained porpoise can spot a ball thrown at it while it's under water, and swim,

[Continued on page 156]

RANGER 6, WHERE ARE YOU?





Something up there is listening
—you hope—as, from the
California desert, you guide a
probe to a lunar landing

By James Joseph

IT IS L plus 12 . . . exactly.”

The voice, like a metronome, marks off the minutes and hours of tension in the control room. We're at the Pioneer antenna site of Jet Propulsion Laboratory's Goldstone tracking station, nestled in California's Granite Mountains, 50 miles north of Barstow.

It is 12 hours since launch—since the 750-pound Ranger probe lifted from Cape Canaveral to jettison its Atlas-Agena boosters and streak toward the moon, some 239,000 miles and 66 hours away. The probe is designed to send back man's first close-up television pictures of the moon's surface, before destroying itself on impact.

Now, nearly 82,000 miles out, its

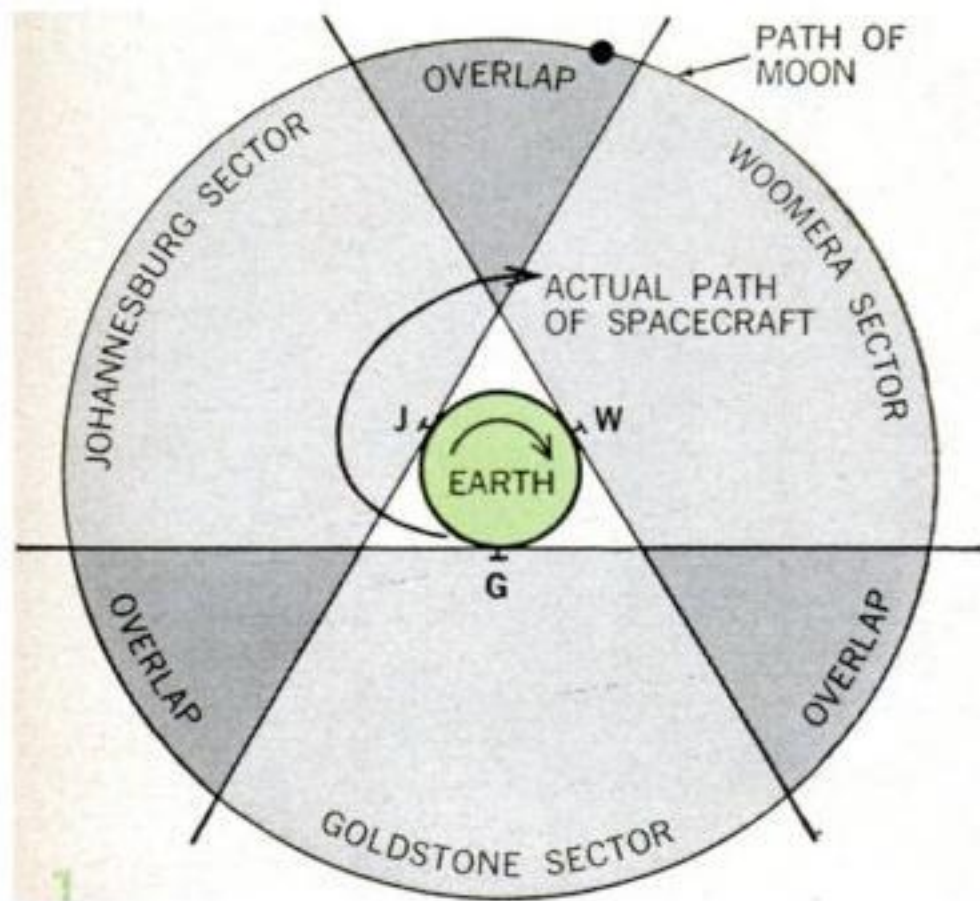
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How spinning earth plays tricks on trackers of a lunar probe

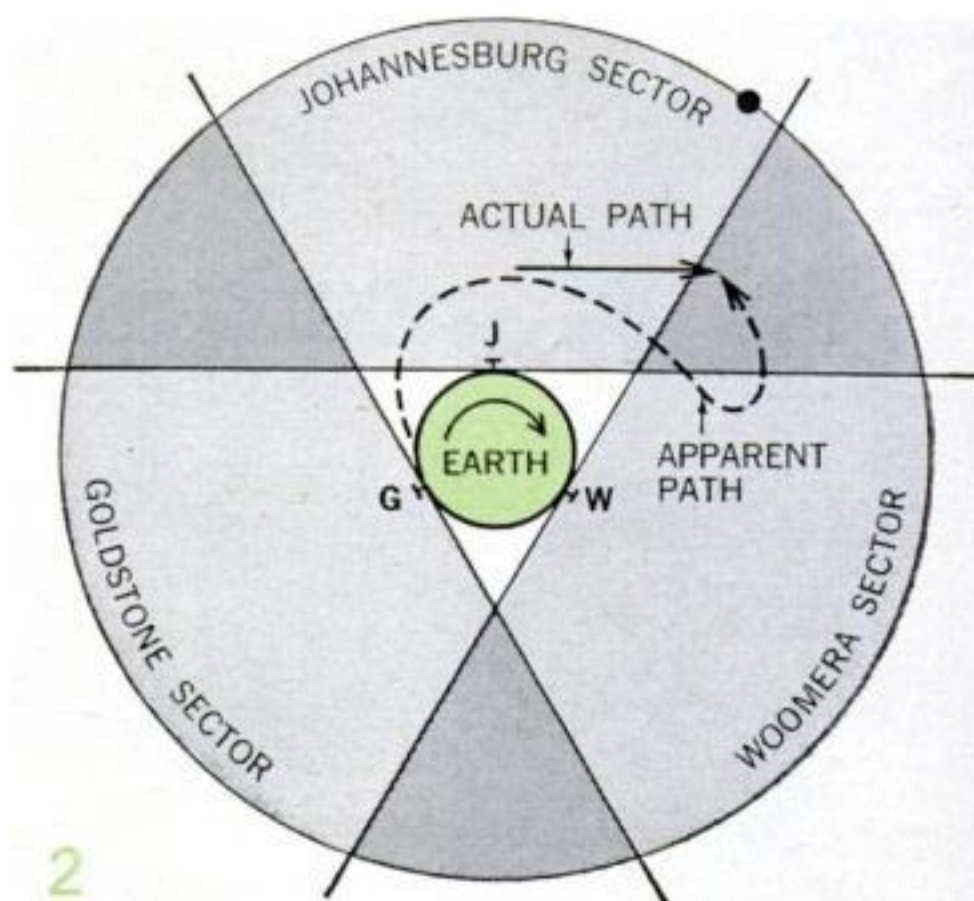
Following the apparent course of a spacecraft on its way to the moon—developed in the picture sequence below—is good exercise in unconventional thinking.

Keep in mind that the earth is shown from above the southern hemisphere. The three tangential lines are projected horizons

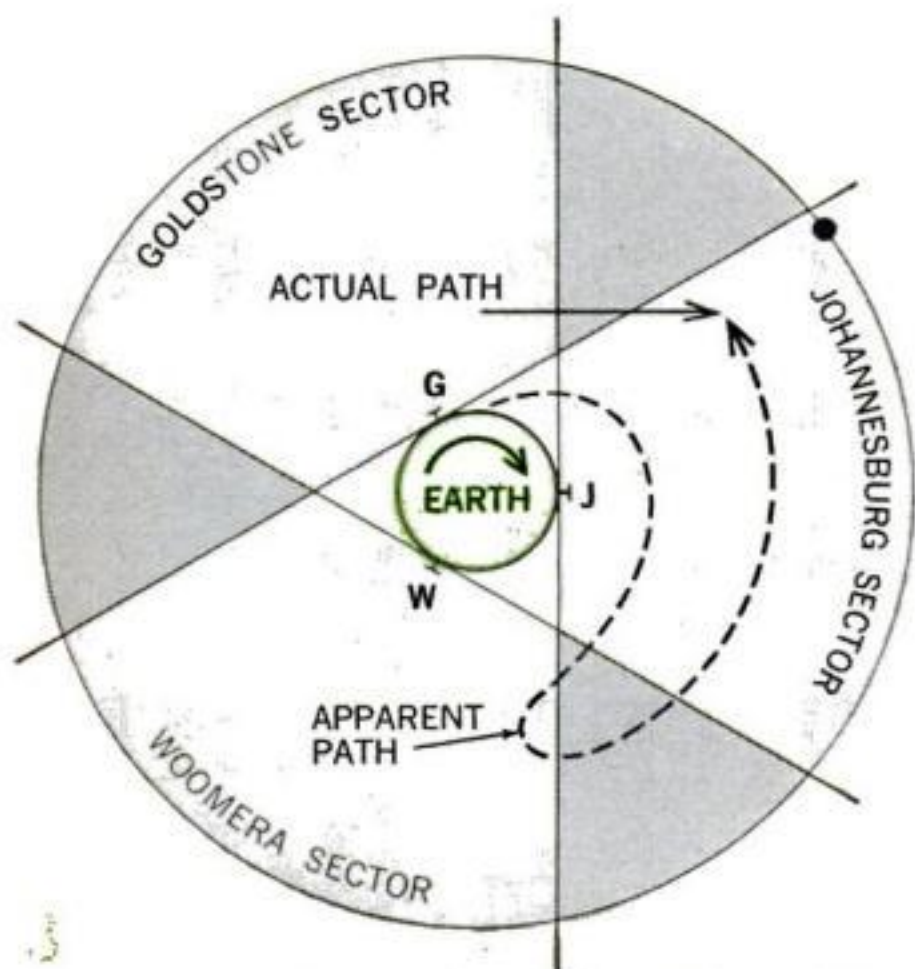
of our deep-space tracking stations: Goldstone, Johannesburg, and Woomera. As perceived by a tracker, the spacecraft's course combines the motions of both earth and probe—as if, while riding a merry-go-round, he watches one of the horses jump off and gallop away.



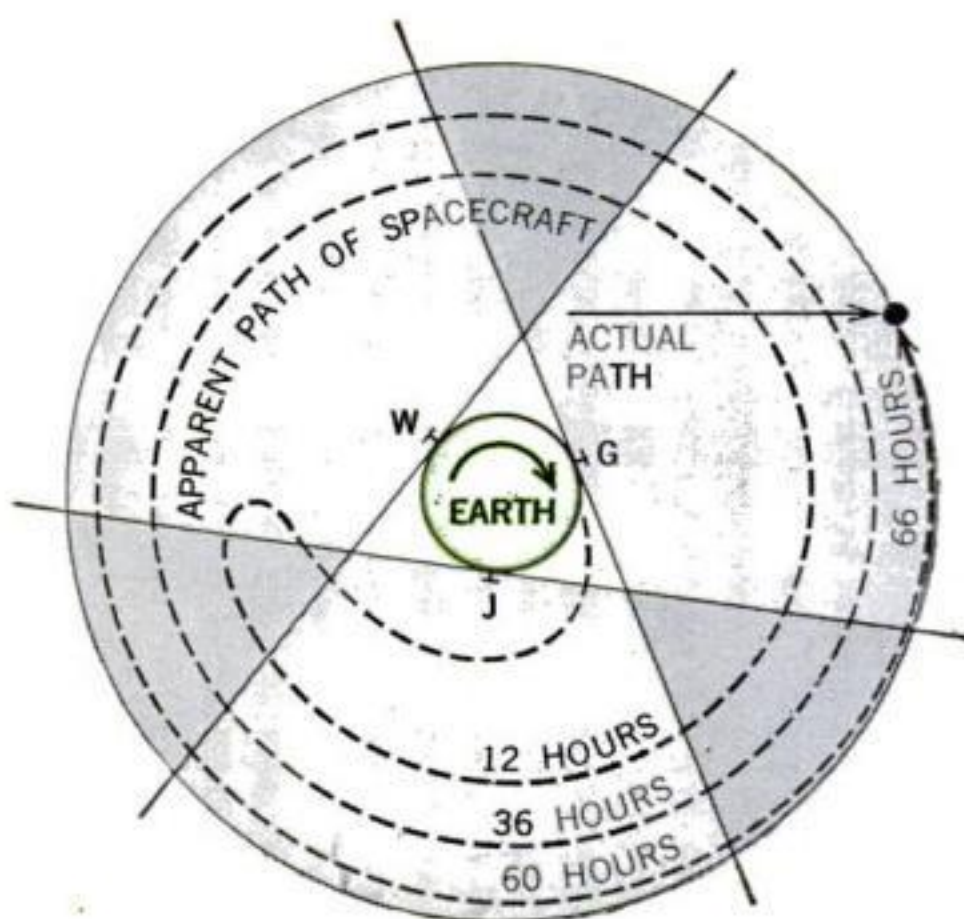
Spacecraft is fired into launch orbit. Heading eastward from Cape Canaveral, it moves ahead of earth's surface, passing over Johannesburg and entering the Woomera sector.



Last stage of booster ignites, injecting probe into lunar flight path, almost straight away from earth. But the turning earth "catches up with" the probe, which seems to turn back.



Probe now appears to hang above the rotating earth, like a star—seeming to rise in the east and set in the west, passing back through the Johannesburg sector of the sky.



Apparent course of spacecraft, from viewpoints of earth trackers, is a widening spiral out to the moon. Actually, the probe does not circle the earth, but the earth turns under it.

transmitter warbling feebly toward earth, the spacecraft is moving through space at 21,500 miles per hour, relative to the earth. It's probably a little off course (due to errors in launch-vehicle guidance).

You're in the tracker's seat. Your needle-in-a-haystack assignment: Find the probe, track it so its course can be corrected, bring back those snapshots.

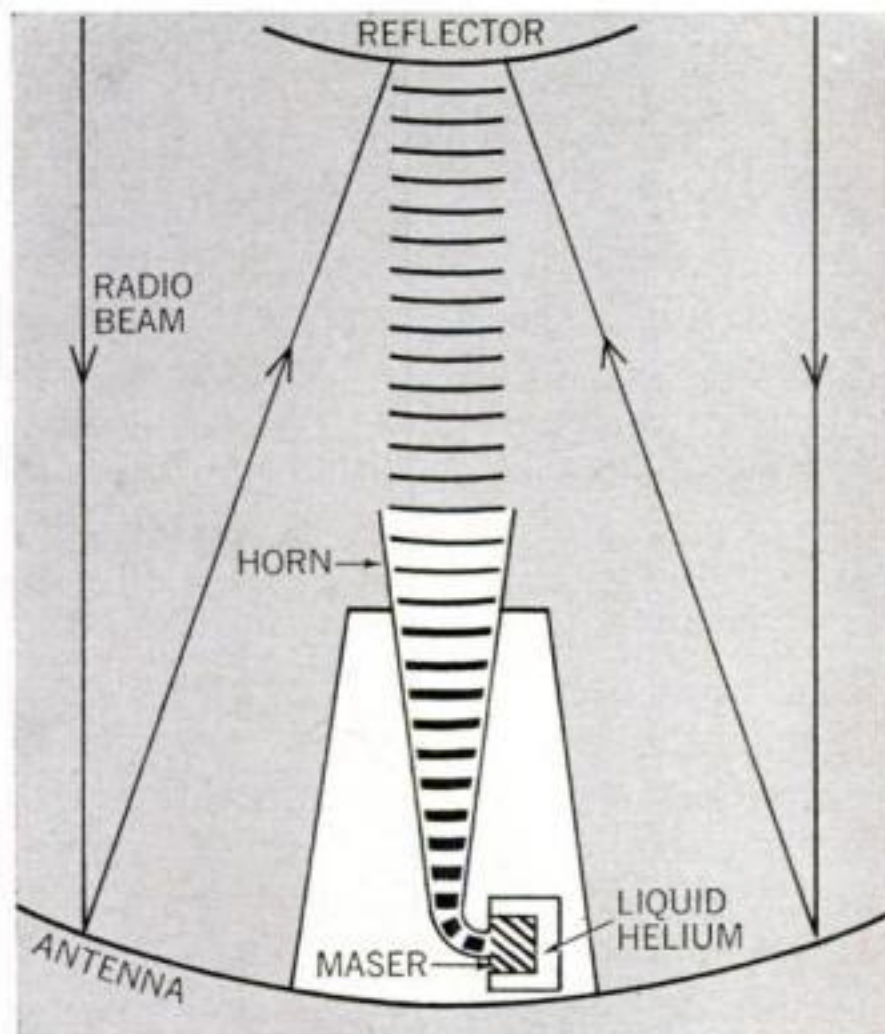
Doing it is like playing baseball in space. The team's pitcher—hurling radio command and control signals to the spacecraft—is at the console of the transmitting antenna, named Echo, seven miles down the road.

You're the catcher, responsible for scooping up streams of fast balls from space—pulses of radio energy moving at the speed of light.

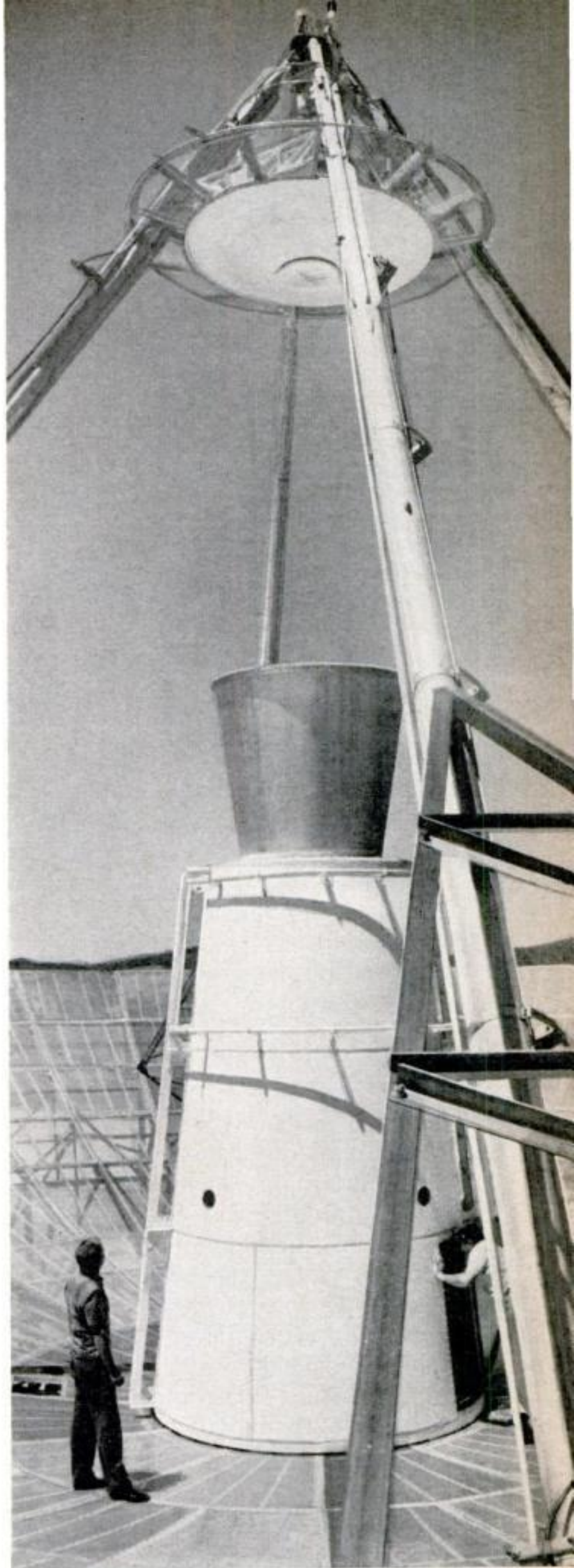
Your catching mitt is a parabolic antenna 85 feet in diameter, standing 11 stories high outside your control-room window. The pitcher's throwing arm is an almost identical antenna. (Goldstone has a third 85-foot dish, Venus, but it's not yet active in controlling spacecraft.)

Since just after launch, the probe has been tracked by the other two stations

CONTINUED



Like a telescope mirror, sensitive receiving antenna focuses incoming radio beam, reflects it into concentrating horn. At the base of the horn is a ruby maser cooled by liquid helium.



"Upstairs" in the perforated aluminum dish, Cassegrain horn rises from center of Pioneer antenna. Ringing reflector above it are four small dipoles used for automatic tracking.



Transmitting antenna named Echo (left) beams commands to spacecraft, telling it how to change course or report data. Above, Goldstone station manager Walter Larkin holds punched paper tape that records coded orders before they are sent. Carefully checked, tape is fed into automatic equipment that translates the code into pulses of radio energy.

in NASA's deep-space tracking net. Goldstone is the main command station, with the most sensitive receivers. The others, also equipped with 85-foot antennas, are at Johannesburg, South Africa, and Woomera, Australia.

Johannesburg was the first station to pick up the Ranger probe as it appeared in the western sky, coming from Canaveral. Then, as it set in Joburg's east and rose in Australia's west, Woomera took over.

The spacecraft was still in its launch orbit, but as the final stage of its booster fired to inject it into a lunar trajectory, it headed straight away from the earth. Then it seemed to set again in Woomera's west, like a star, as the earth turned beneath it.

Because of the apparent turnaround, Johannesburg picked up the signal again and tracked the bird from east to west. In a few minutes it will be Goldstone's turn to "acquire" the spacecraft for the first time.

Penalty: a 100,000-mile miss. Hunched over the acquisition console, you scan the meters on the panel. Miss that radio beam—small as a dust speck in the ocean of space—and, conceivably, the space-

craft may be lost forever. Garble the track—lose even a minute's communication—and irretrievable data will be lost. That data might make the difference between a lunar bull's-eye and a 100,000-mile miss.

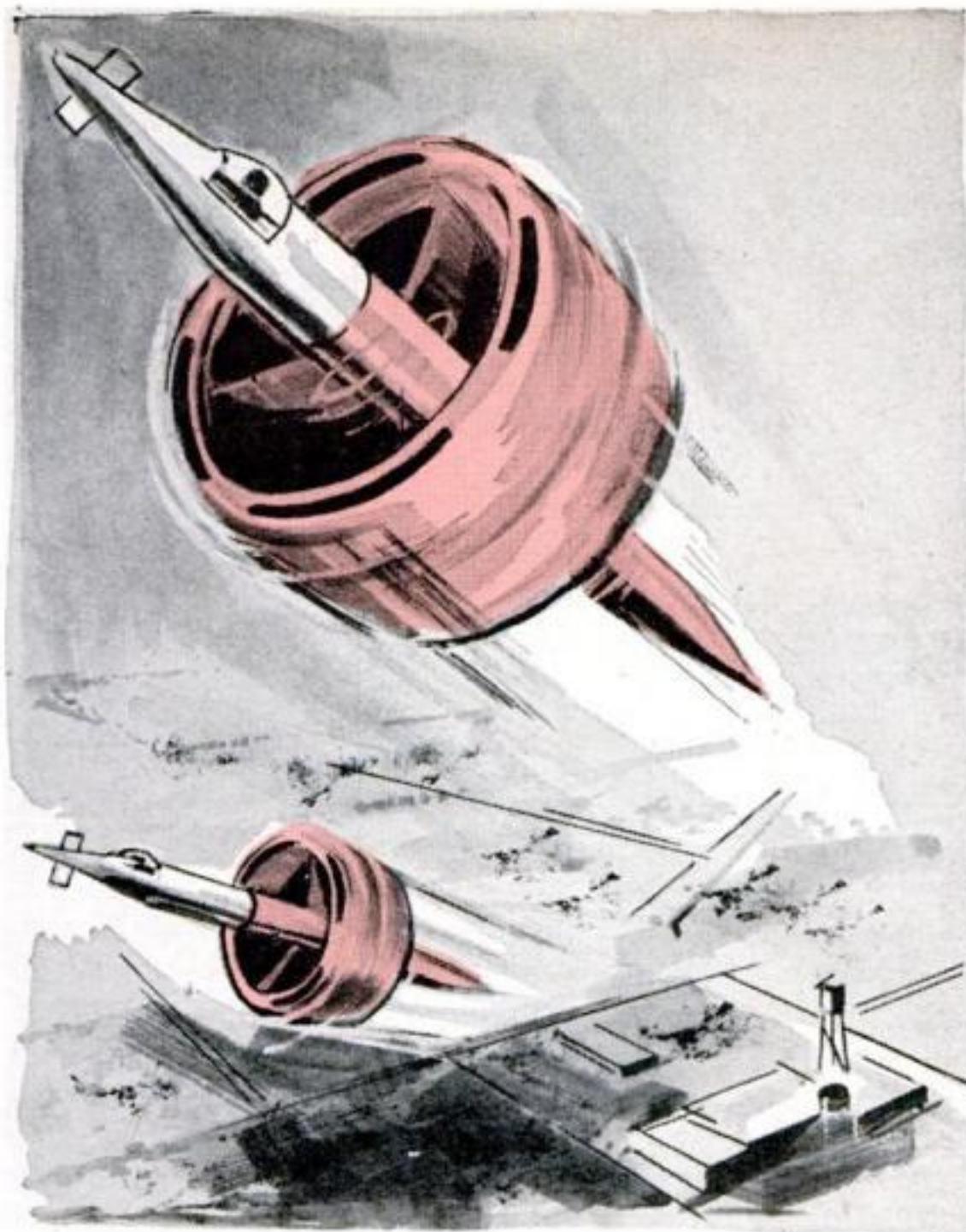
You flip the switch that sets your receiver for acquisition. Like an astronomical telescope, the Pioneer and Echo antennas swing in equatorial mounts. In such a mounting, the main axis points to the North Star. Where the dish points as it rotates on this axis is called the hour angle, and its aim relative to a second axis—at right angles to the main axis—is called declination.

At your left, one of the two servo men who control the motors slowly searches the antenna across a sector of the sky. The other man controls declination. Behind you stands the operations chief, listening for instructions through his earphones, his voice calling the signals.

"It is L plus 12 hours and 25 minutes . . ." Five minutes to acquisition.

The teletype clatters. It's a new "look angle" determined by the computers at JPL's headquarters in Pasadena, on the basis of data received from Johannes-

[Continued on page 170]



New ideas from the inventors

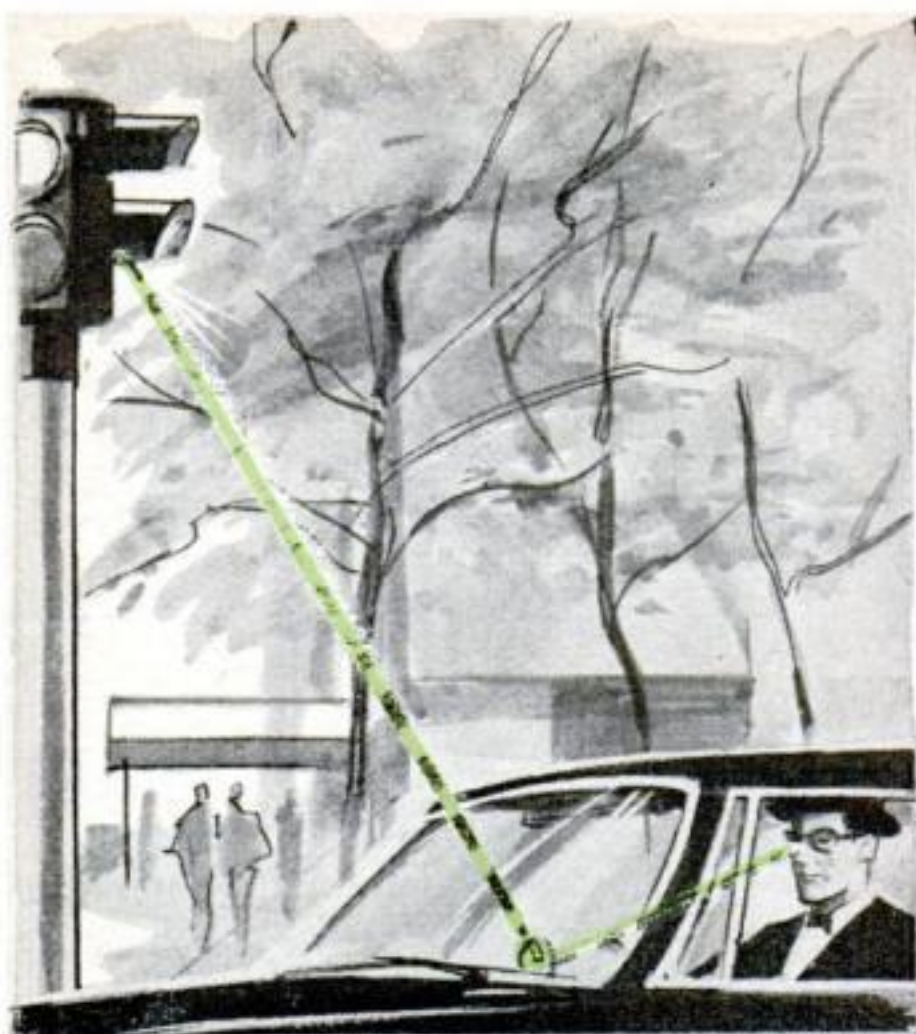
Spinning wing lifts plane. A rotating annular wing, according to this recent Lockheed patent, would act as a gyro to stabilize a plane in supersonic flight. The wing's upper and lower surfaces would provide lift, and centrifugal force would deliver fuel to ramjet engines in the wings. Intake-air flow would be smoothed as it broke around the nose.



Play-through cover protects disc. You wouldn't have to worry about damaging your records if they were enclosed in these permanent jackets. After placing the cover-protected disc on the turntable, you'd insert a pin, to keep the jacket from turning, and engage the stylus through a slot. The record would turn on a bearing plate.



Flag signals shallow water. At low tide or in unfamiliar water, you'd navigate more confidently if you had a flag-ended feeler like this pivoted to the hull of your boat. Opposed springs normally would hold the arm upright. On contact with an obstruction, the flag would dip, alerting you to avoid a fouled prop or scraped bottom.



Traffic-light viewer is reflector, too. This overhead-traffic-light viewer has another job, too: Its front face, of colored glass, would reflect back the headlights of on-coming cars to indicate to their drivers your car's width—useful if one of your headlights burns out. A lens at top would pick up overhead traffic lights.



Electric basin heats water. A sink like this at your country cabin might give you hot-water convenience on a boilerless budget. The basin would nest in a tank fitted with a coil heater. Two taps would feed a mixer faucet from a single inlet, but turning the hot tap would route the flow of cold water through the heating tank.



Trailer doubles as boathouse. With this amphibious carrier, you could trailer a winched-up boat to the water, let down the pontooned side panels (to serve as walk-

ways), and lower the boat directly into the water. The trailer would serve as a floating dock in boating season and, covered, as a boathouse during the winter layover.

The following patents have been issued on these inventions: Spinning wing—No. 3,065,932 to W. E. Herrmann, Northridge, Calif.; Record cover—No. 3,062,552 to B. A. Schwarz, Kokomo, Ind.; Boat signal—No. 2,966,132 to R. B. Mattson, Woodbury, N.J.; Light viewer—No. 3,051,055 to W. C. West, Baton Rouge, La.; Electric basin—No. 3,065,473 to C. L. Sporck and W. H. Busch,

Cincinnati; Trailer-boathouse—No. 3,065,721 to W. J. Roudabush, East Orange, N.J.

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.

DOUBLE-LENGTH FEATURE
OF TRUE SCIENCE ADVENTURE

When Boats Had Wings

Queens of the transoceanic
air lanes for a brief reign,
the flying boats bred some
huge and awesome birds for
luxury air travel

By Wesley S. Griswold

Transatlantic debut: Big flying boat boards first passengers at N. Y.



CONTINUED

71



Boeing 707 jetliner
(Not a seaplane; shown for size comparison)



Dornier Do-X



Lt. de Vaisseau Paris



Sikorsky S-42



Boeing 314 Clipper



Navy PB2Y Coronado



Martin Mars



Hughes Hercules



British Princess

How the big flying boats stacked up in size

Twelve wing-top engines made the 52-ton Do-X awesome in 1931. But the flying boats became bigger and bigger (although with fewer engines). Tops was the Hughes Hercules, weighing in at 150 tons and with an incredible 320-foot wingspan. In between were more modest models, including the Boeing 314 that made Clipper history. Planes are shown (with exception, of course, of Boeing 707) in order of appearance in aviation history.

FIFTY thousand people crammed New York's little Battery Park. They peered down the busy harbor through a haze of August heat.

Suddenly, a few minutes past noon, they spotted what they had been eagerly expecting. Out of the seaward murk emerged the biggest, noisiest airplane that anybody there had ever seen or heard.

The perspiring crowd burst into wild shouts and cheers. Bands struck up *Die Wacht am Rhein* and *Deutschland über Alles*. Tugboat and ferry captains tied down their whistles.

This raucous welcome, on Aug. 27, 1931, was for the German Republic's monstrous, 12-engined Do-X. It was the world's largest flying boat. It was also, up to that time, the biggest heavier-than-

aircraft ever built. Escorting planes looked like gnats beside it, an observer wrote. Its great wing, with six pairs of engines perched back to back in a row along the top, stretched nearly 158 feet. Its three-decker hull, made of duralumin braced with steel girders, was 131 feet long. Loaded to capacity, it weighed 52 tons.

The throbbing, silvery Do-X slowly settled to a sedate landing off the Battery. Seventy-two passengers and crewmen—an astonishing number for the time—climbed out. Their stories were conflicting. Passengers (some had just been dancing to accordion music over the ocean) said they'd had great fun. But they had shared only the easiest part of a long, troubled journey. The crew, which had nursed the flying boat all the way from its home berth on Lake Constance, were far less enthusiastic. They had plenty of reasons to be sour. The Do-X, said to be capable of crossing the Atlantic in 40 hours, had taken nearly 10 months for its first trip.

Birth of an era. The romantic era of crossing oceans in boats with wings had barely begun. No land-based airliner then had range enough to make such long, dangerous hops. None had anywhere near enough room inside to make an ocean flight economically practical, anyway. Besides, there were few airports. On the other hand, most of the world's major cities lay close to bodies of water. Flying boats could land and take off there easily. They could also alight with reasonable safety on any ocean if they got into trouble above it. Flying boats made sense. For nearly 20 years, they were to be queens of the oceanic airways.

Then World War II brought about vast improvements in land-plane power plants and airframes. It also left hundreds of new airfields scattered around the globe. All at once, there was no need for flying boats. They faded away. In their heyday, though, some bizarre birds were hatched. The Do-X was one of the oddest specimens of an extraordinary breed.



Dornier Do-X. First of the big transoceanic flying boats, it had a brief day of glory.



Lt. de Vaisseau Paris. Made transatlantic survey flights; never got into passenger service.



Boeing B-314 Clipper. Went into transatlantic service in 1939; had a bridal suite aft.



Martin Mars. Built as a Navy bomber in 1942, it took on the humbler role of cargo carrier.



Hughes Hercules. The 150-ton plywood giant outsized them all, flew once—about a mile.

British Princess. Last of the big "boats," it came too late. May be reborn with nuclear power.



From Rio to New York, the big Dornier Do-X flying boat droned along at around 100 m.p.h., never far from land or high above the waves. It made frequent stops for fuel and to pick up passengers.

Pilots' compartment

Bridge for captain and navigator

Engine control room

Radio room

Captain's quarters

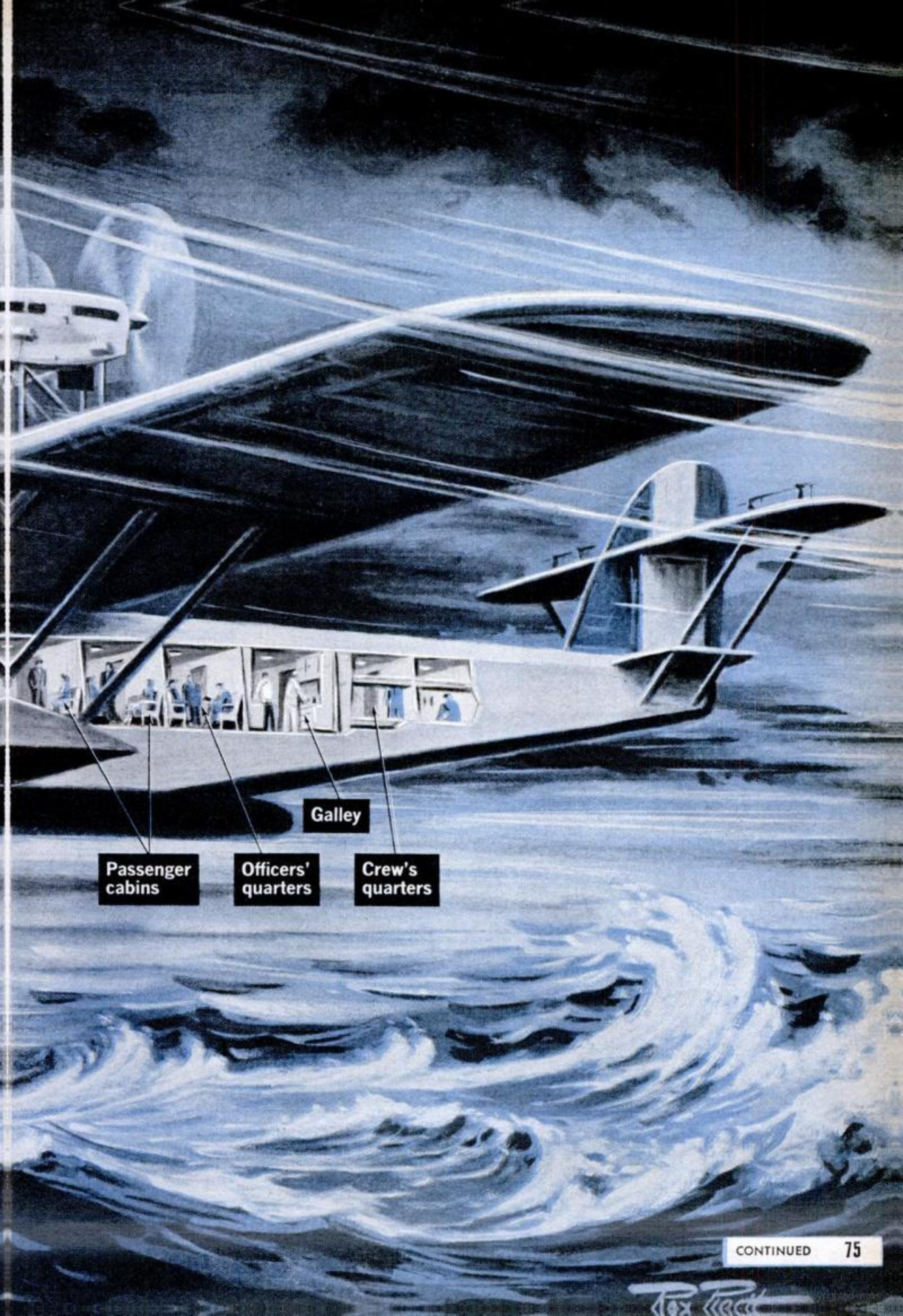
Baggage room

Passenger cabins

Fuel tanks

Dining saloon and social hall

Companionway and hatch between decks



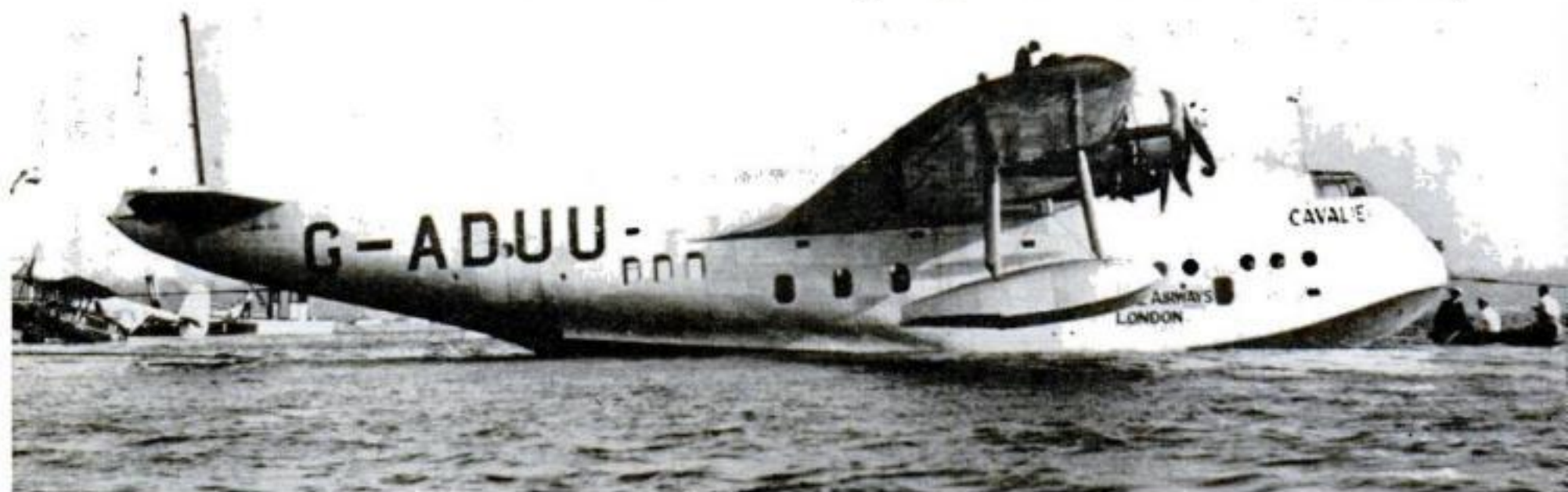
Passenger
cabins

Officers'
quarters

Galley

Crew's
quarters

British and U.S. flying boats simultaneously



Transatlantic survey flights were made simultaneously by England and the United States in

July, 1937. British flew the Empire Short, which is shown at left moored off Port Washington,

The luckless jumbo. The "Do" of Do-X was plucked from the last name of its famed designer, Dr. Claude Dornier. Nobody seemed to know what the "X" stood for. It turned out to be a prophetic symbol. The Do-X (Germans pronounced it "Dough-Iks") was a washout. After one transatlantic round trip, spread over a year and a half, its career ended.

The short, unhappy life of the Do-X began with a spectacular stunt. On Oct. 21, 1929, the newly completed flying

boat took up 169 people—14 tons of human beings—for an hour's ride around Lake Constance. Even the largest dirigibles hadn't carried half that many passengers. The Do-X had regular accommodations for only 72, but enough folding benches and chairs were taken aboard to seat everybody. Luckily, the craft hit no sizable air pockets during its dramatic debut. The flight made news around the world.

There was a buzz of talk, too, about the remarkable appointments of the big flying boat. It had a spacious "saloon" for dining or card-playing. It had an electric kitchen, a cozy bar, and shower baths. The passenger deck was divided into attractive compartments containing divans that converted into beds. There was lots of comfort but little privacy: A corridor cut through all compartments.

On the top deck was a pilots' compartment where the pilot and copilot looked out through plate-glass windows. Behind this were a bridge, for the captain and navigators; an engine control room, for the flight engineer and three assistants; and a radio room. The crew slept in quarters aft of the passenger deck.

After its brief but stirring maiden flight, the Do-X was not heard from again for 11 months. Meanwhile, it got a new wing. Its 12 air-cooled German engines were removed. A dozen water-cooled American engines, developing a total of 7,200 hp. (compared with an



Clipper service was deluxe. Meals were actually cooked in flight. British passengers often dressed formally for the cocktail-and-dinner hour. State-rooms were available for extra privacy.

blazed pioneer paths across the Atlantic



N.Y. The U.S. entry was a Pan Am Sikorsky S-42, pictured above, a veteran of Caribbean

flying-boat passenger service. It made a smooth and routine flight to Southampton.

equivalent 30,000 hp. for today's four-engine 707 jets), took their places. They were mounted back-to-back along the top of the wing. The front propellers were pullers, the rear ones pushers.

Westward bound. On Nov. 4, 1930, the huge craft set forth from Germany on its first and only flight to the U. S. Winter was coming. The North Atlantic route was too risky to try. The Do-X took a widely circuitous, southerly course. At the start, it carried no passengers. This was fortunate.

Between Southampton and Bordeaux, it was forced down at sea in bad weather. It had to taxi 60 miles through darkness and rough water to an alternate port.

At Lisbon, its wing caught fire and was half destroyed. Repairs consumed more than two months.

By the end of January, 1931, the Do-X had got only as far as the Canary Islands, off the northwest coast of Africa. There, preparing to cross the South Atlantic to Brazil, it began a series of takeoff-and-landing tests with ever-increasing loads. At a gross weight of 55 tons, the hull caved in.

Finally, in May, the star-crossed craft was ready to go again. Before it took off, however, it was stripped of all its finery. The crew, some of them later complained, were told to take nothing with them but a toothbrush and a razor. Every spare pound of cargo capacity

was reserved for carrying extra fuel.

Boosted by an obliging tail wind, the Do-X made the 1,400-mile flight to Brazil without stopping and without a hitch. Then it was entirely refitted, in Brazilian elegance, and ambled down to Rio to pick up its first paying customers.

From Rio to New York, the big Dornier droned along, never far from land or high above water, at around 100 m.p.h. It stopped frequently to refuel. In the U.S., it touched down at Miami, Charleston, and Norfolk, adding passengers at each halt.

"We lounged in luxury, played bridge, danced, stretched our legs, strolled to the bar—outside the 12-mile limit, of course—and dined on the fat of the land," one of them reported upon arriving in New York.

What about the noise of those 12 engines?

"Why," declared a passenger, in one of the most remarkable statements ever made about flight, "the noise didn't intrude *unless you opened the portholes.*"

(A later passenger disagreed entirely. He flew back to Germany in the Do-X, wore earplugs all the way, and swore he was nearly deafened.)

After its day of glory in New York, the Do-X retired to a sheltered anchorage on the North Shore of Long Island. There it sat for nearly nine months.

In the meantime, bald, mustached Claude Dornier came to New York by

What's it like today to ride in a flying boat?

The other day, I took a delightful airplane ride that carried me 20 years into the past. For 12 minutes, in a craft called Mother Goose, I enjoyed stimulating whiffs of the forgotten atmosphere of ocean crossings in the romantic era of flying boats.

The flying boat I rode in was a veteran of those venturesome days, a Vought-Sikorsky 44A, completed in 1942.

This 25-ton, four-engine boat with a 124-foot wing was intended for peaceful transatlantic passenger service. Instead, when it was ready to fly, it was promptly drafted into the Navy. It was built to carry 16 passengers on sleeper jumps, 20 on shorter flights. With its 5,000 hp. and its five tons of fuel, it could fly 3,750 miles. That was the longest range a commercial flying boat ever had. Since it was not pressurized, it didn't climb above 12,000 feet. But up there it could cruise at 185 m.p.h., faster than any other flying boat of its day. With everything in its favor, it could fly from New York to Ireland in 12½ hours.

The VS-44A safely survived the war and a spell of haphazard flying in South Ameri-

ca. Now, still young in flying hours, it has been stripped of its Pullman-like berths and most of its electric kitchen. One compartment, arranged like steps from stern to bow, contains only seats. Its former cargo hold, up forward under the flight deck, has also been converted into seating space. Thus it has become a 47-passenger aerial ferry for California's Avalon Air Transport, and daily hops a 28-mile sliver of the Pacific. It makes 1,000 round trips a season between Long Beach and the principal harbor of Catalina Island. What's more, it makes them joyously memorable.

I boarded the Mother Goose at a typical flying-boat anchorage in sheltered Long Beach Harbor. The other passengers and I walked out an L-shaped floating dock and stepped through a doorway near the tail.

Fore-and-aft mooring lines were quickly cast off. The engines started with a minimum of fuss. Almost at once, we began moseying out to a point in mid-harbor. There we swung into the wind, and the engines roared in chorus. Off we went.

At first, it was like a super-speedboat

ship. He was there, he said, to discuss with General Motors and Fokker Aircraft the possibility of building more Do-Xs, and bigger ones.

His timing couldn't have been worse. The Big Depression, steadily deepening, killed all chances for Dornier's scheme.

Back to Germany. In May, 1932, the Do-X flew home. This time it crossed the Atlantic in two days, but the flight was no recommendation. Though the gawky craft was supposed to have a service ceiling of 17,000 feet, it was hardly able to clear the water. For eight hours out of Newfoundland, battling strong head winds, it never rose above 50 feet.

Amelia Earhart flew eastward across the Atlantic alone that same day, May 20, 1932. She was the first woman to do so. The altimeter in her red-and-gold monoplane failed en route, but she landed safely in an Irish cow pasture. The Do-X, on the other hand, ran out of fuel in the dark, seven miles short of its port in

the Azores, made an emergency landing.

The chief pilot said afterward that he couldn't see either water or land as he set the big plane down.

Two days later, the Do-X reached home. It got a big welcome from Berliners, but promptly disappeared from aviation history. It was abandoned as too heavy and too costly to run. Twelve years later, it was blown to bits during an Allied bombing raid on Berlin.

Gallic contender. The French had a try, too, at producing the "world's largest" flying boat. It made its bow on Jan. 15, 1935. With the Do-X no longer in the running, the French entry in the transoceanic sweepstakes seemed to deserve the title, even at a somewhat lower gross weight, 37 tons. Its name—Lieutenant de Vaisseau Paris—was in keeping with its size. Its wingspan was 162 feet. Its double-decked hull, 30 feet high, was 104 feet long. Its six engines, with four tractor and two pusher propellers, produced 5,100 hp.



"The plane was comfortable and solid, noisier than a jet but not disturbingly so."

ride. The Vought-Sikorsky sped faster and faster until the surrounding water was a glittering blur. We were doing 85-90 m.p.h. at takeoff. Then we lifted steadily into the calm, clear sky and climbed to 700 feet.

The plane was comfortable and solid, noisier than a jet but not disturbingly so.

Landing in Avalon Harbor was more exciting than takeoff at Long Beach. The speed was the same, but here, though in

the lee of the long island, we were in open sea. There were swells, lazy but perceptible. We slid into the water almost without noticing, then took a couple of exhilarating bounces as the sea heaved. We swooshed to a stop with the spray flying past the windows as if batteries of fire hoses were playing along the sides. Then we taxied to another floating dock and were firmly moored. I was sorry the trip was over.

In one respect, the big Gallic bird was unique among all aircraft of every era. It had 12 private bathrooms. They went with 12 deluxe, double-bedded cabins—"as big as those on transatlantic liners," the press said. There were seats for 42 second-class passengers, a bar, and a kitchen. A crew of seven operated the plane.

The Lieutenant de Vaisseau Paris was built to fly across the Atlantic in 20 hours. It never quite lived up to that promise, and it never went into actual service. After three prolonged Atlantic survey flights in the years from 1935 through 1939, it vanished as completely as the Do-X.

It paid a last, flurried call at New York in late August, 1939. Hitler then was screaming at Poland, and France was supporting its eastern ally. On Aug. 27, the Lieutenant de Vaisseau Paris abruptly left New York, undoubtedly summoned home by its government. It never appeared in the news again.

Brightest example of the worth of flying boats was the development of Pan American World Airways. Though one of Pan Am's early models caused a sailor to exclaim, "That's a helluva way to carry a boat," flying boats pioneered all the transoceanic routes of that system. During World War II alone, they flew a total of more than 201 million miles, including nearly 18,500 ocean crossings.

Yankee Clipper. The most famous, and the biggest of Pan Am's Clippers was the Boeing 314, the first Yankee Clipper. It made its maiden flight across the Atlantic on May 20, 1939, exactly 12 years after Lindbergh.

This 42-ton flying boat, with four 1,500-hp. engines, was very different from the Spirit of St. Louis. Its 152-foot wing was the same type that the huge B-29 Air Force bomber later used. Its double-decked hull was 109 feet long. The "flight deck," as it was called, was an eyepopping sight to the pilot of any

[\[Continued on page 173\]](#)



Stability in turns is good, although the car leans heavily. It corners without fuss—but don't try it too enthusiastically. The front end may skid.

REPORT FROM THE DRIVER'S SEAT

SKYLARK:

By Alex Markovich

ONCE upon a time, the name Buick suggested a conservative car built to appeal to the successful, but not too adventurous, professional man. The Buick Skylark—a more muscular, tinselled version of the compact Special—is far from that image.

A trace of the traditional, billowy ride remains, though the suspension is firmer than that of the Skylark's big brothers. The impeccable Buick finish inside and out remains. But the accent is on sporty driving. An additional 45 hp. in the form of a four-barrel carb has been added to the standard

V-8. Individual front seats spice up the interior. You can get a four-speed floor shift, tachometer, heavy-duty suspension, and other such extras. That middle-aged professional man will find it tough getting his Skylark away from Junior.

Our test car turned out to be extra-sporty—a convertible with screaming red paint and “four on the floor.” Unhappily, though, the odometer registered only 65 miles. A well-run-in car could have gotten better miles-per-gallon figures.

Out of respect for Things Mechanical, I put on 300 miles before starting the acceleration runs. These figures, too, could have been better with 1,000 or more miles

on the clock, but even so this baby rolled.

Adding to the fun was that delightful Borg-Warner fully synchronized four-speed box. It's crisp and smooth, and it never makes impolite noises. Gear spacing is excellent. It's a close-ratio box that's ideal for all kinds of driving except standing starts; there the high first gear bogs down the engine. But rather than spoil the box with a wider spread between first and second gears, I feel that lower rear-end gearing would be a better choice.

Except for this initial timidity, the engine is smooth, responsive, and quiet throughout its operating range. The body is tight and well insulated from road noise.

Handling is respectable, but not outstanding. Lean is pronounced. The Skylark is an understeerer; it's not the fastest-cornering car made, but it gets around without unnecessary drama.

Ride is good except on really rough surfaces, where excessive bobbing indicates a need for firmer shock absorbers. Brakes are adequate under normal conditions, but prone to fade after several panic stops. The power steering is numb and a bit on the slow side (but considerably faster than the manual system).

On the plus side, the Skylark has many small niceties that the competition skimps on. The large windshield wipers are parallel-acting, resulting in excellent wet-weather visibility. The convertible-top latches fall into place by themselves, making it easy



Engine components are easy to service; battery is right up front, and all spark plugs can be reached without fear of bloodshed.



Floor stick is easy to reach. Speedometer is hard-to-read horizontal type. Dash has been plentifully supplied with warning lights.

to lock them with one hand. The trunk is cavernous.

No, the Skylark isn't a sports car. Nevertheless, it's fun. ■ ■

Buick's Sporty Special

FACTS ON THE SKYLARK

Model: convertible

Factory suggested price: \$3,458.59*

Engine: aluminum V-8; 200 hp. @ 5,000 r.p.m.; maximum torque, 240 pounds-feet @ 3,200 r.p.m.; bore and stroke, 3.5 by 2.8 in.; displacement, 215.5 cu. in.; compression ratio, 11:1; carburetion, 4-barrel; weight (lb.) per hp., 14.5; engine revs. per mile, 2,754; piston travel (ft.) per mile, 1,285; fuel required, premium; crankcase capacity, 4 qt. **Fuel capacity:** 16 gal.

Transmission: four-speed; ratios (:1): 2.54,

1.92, 1.51, 1.00; reverse, 2.61.

Axle ratio: 3.36:1. **Steering ratio:** 20.8:1.

Turns lock to lock: 4. **Brake swept area:** 223.84 sq. in. **Tire size:** 6.50 by 13.

Outside dimensions: wheelbase, 112 in.; track front and rear, 56 in.; overall length, 192.1; width, 70.2 in.; height, 52.4 in.; ground clearance, 5.18 in.

Curb weight: 2,907 lb.

Weight distribution: front, 53.3%; rear, 46.7%.

Speedometer error: indicated 60 m.p.h. is actual 58.5 m.p.h. **Odometer error:** + 1%.

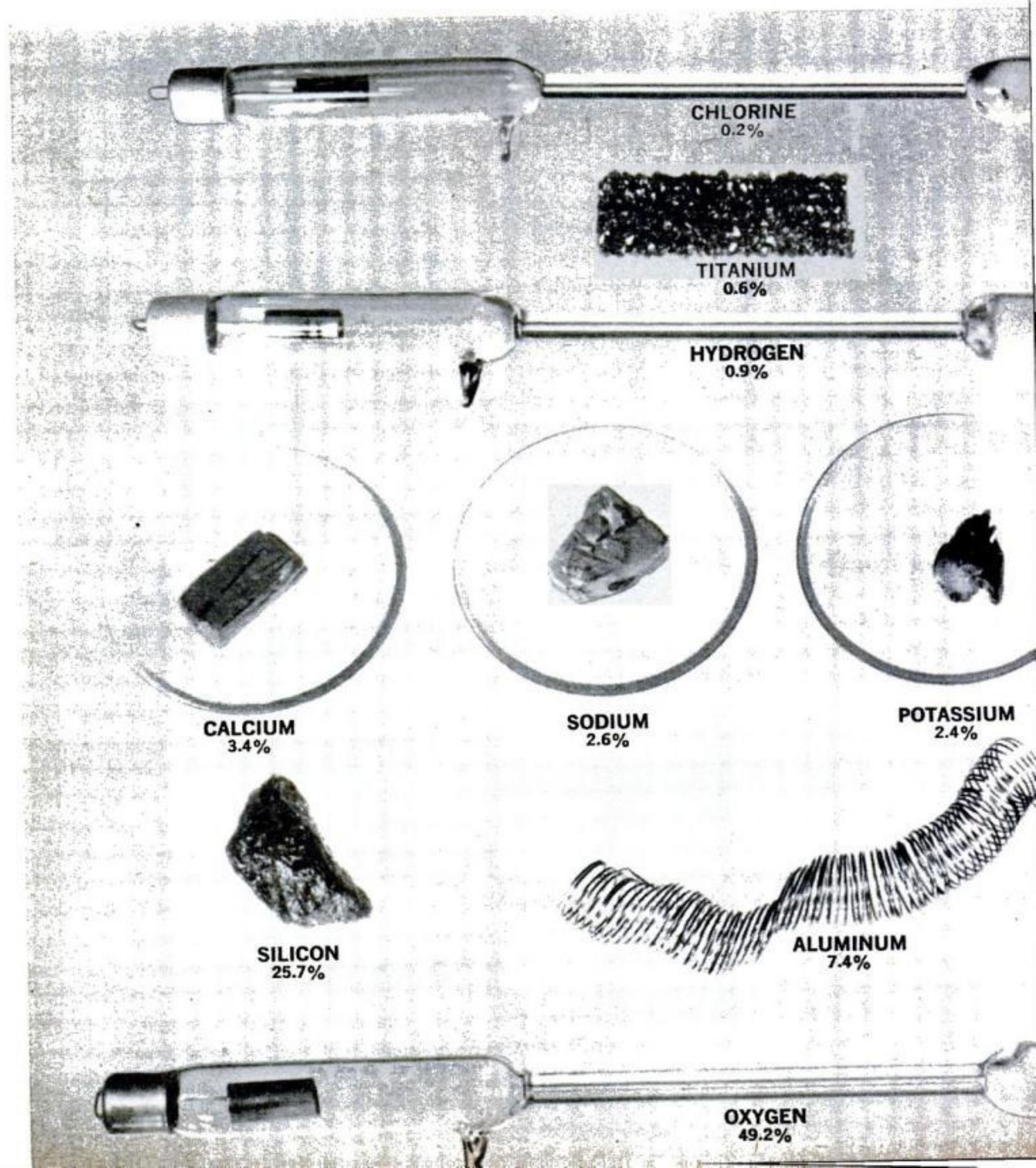
Gas mileage at constant speeds (gallons): 30 m.p.h., 25.3; 40 m.p.h., 24.2; 50 m.p.h., 22.6; 60 m.p.h., 20.9.

Acceleration (seconds): 0-60 m.p.h., 10.7; 40-60 m.p.h., 4.7; 50-70 m.p.h., 7.0.

Top speed: 111 m.p.h.

* As equipped, includes federal excise tax, but no state or local taxes, transportation, or dealer preparation.

He's Got the Whole World in His Hands



88 of the earth's elements are found in nature. Charles Hammond has collected 83 of them. Here's how you can get in on this fascinating hobby

Charles R. Hammond, element-collecting champion, displays his 83 trophies. Gases in tubes at rear glow with characteristic colors (neon, red; xenon, blue) when he applies high voltage from hand-held Tesla coil.



By Alden P. Armagnac

TO A part-time astronomy instructor's home in West Hartford, Conn., the postman recently brought a package containing a tiny silvery nubbin. Feasting his eyes on it, Charles R. Hammond could now add ultra-rare scandium metal to one of the world's most unusual collections.

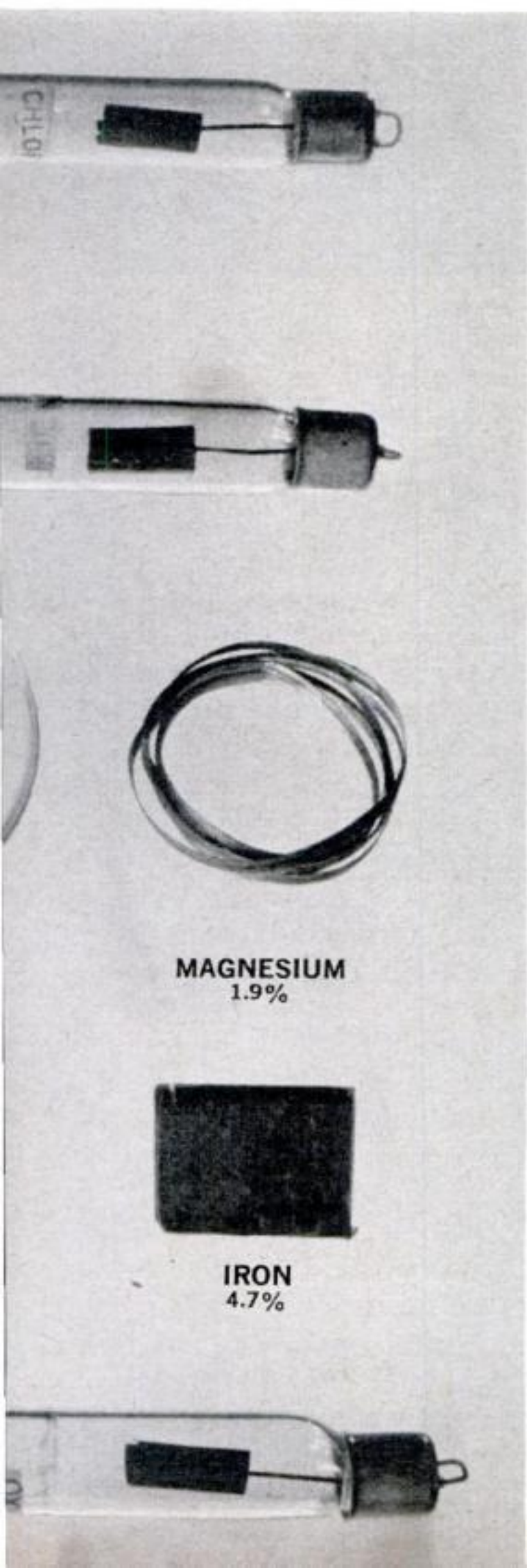
Hammond collects chemical elements—the few-score primordial substances of which all else is made. Samples of the 83 he's gathered in the last two years fill bottles, vials, and tubes in his basement lab. His collection is perhaps the most extensive one in private hands anywhere.

His evening-a-week astronomy course, at the University of Hartford, stressed the elements' distribution in the universe—a clue to the mystery of creation. The idea of showing his students the actual elements was what started his quest.

Others had tried it. The Museum of Natural History at Springfield, Mass., displayed about 40 elements. Chicago's Museum of Science and Industry had 70. Hammond set out to top that.

Just 103 elements are known. Some, like the A-bomb metal, plutonium, are man-made in atomic labs. There remain 88 found in nature—at least, in more than infinitesimal traces on earth. That's what a collector

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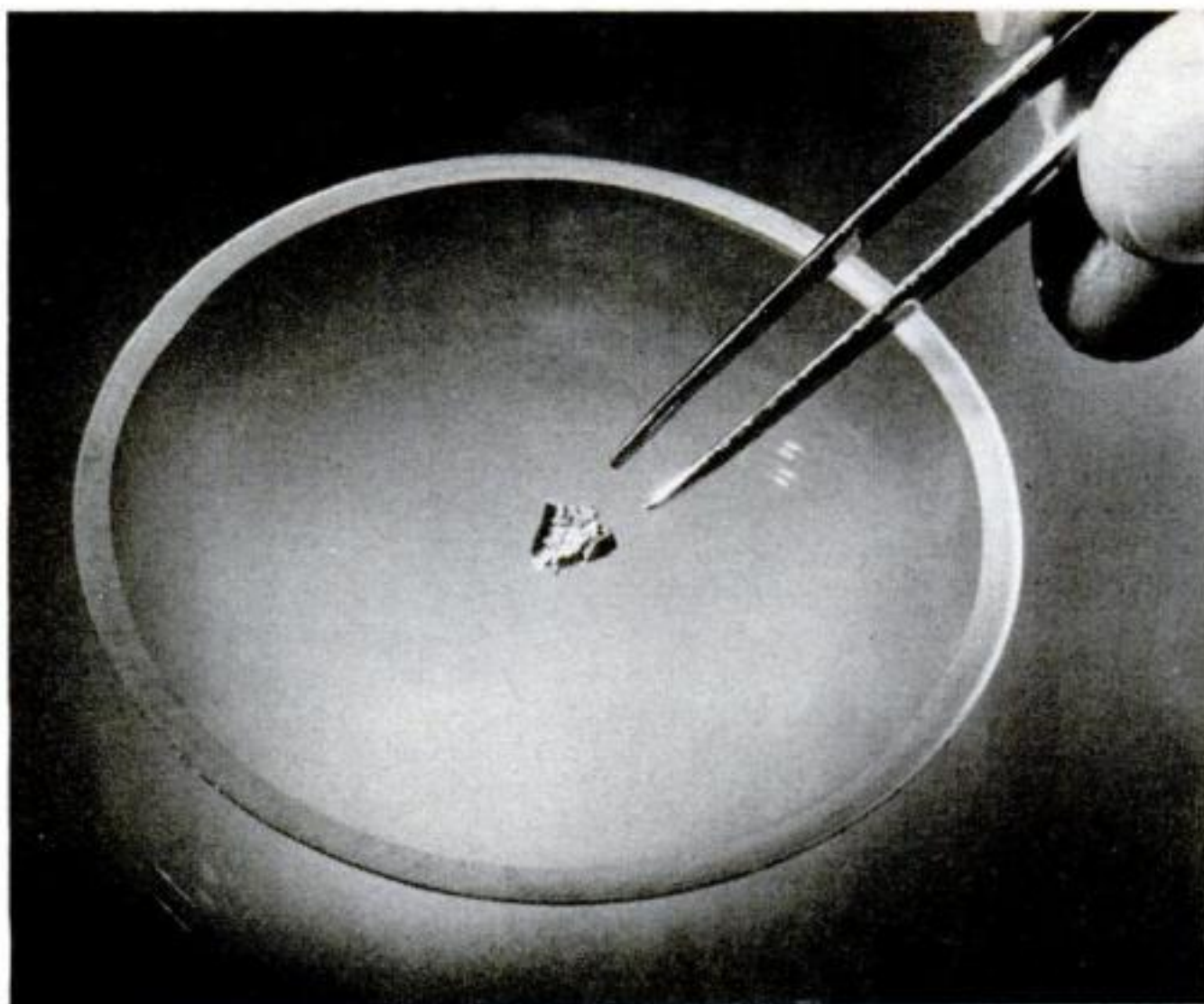


These make up the world

Remarkable picture assemblies, with Hammond's specimens, the 11 elements that form 99 percent of the world we live in—the earth's crust, including land, sea, and air. Labels show proportions by weight. Seldom seen as elements (usually joined to others in chemical compounds) are sand-forming silicon, and calcium, sodium, and potassium metals. The last three, kept under kerosene because they are quickly altered by moisture in the air, were fished out momentarily for photo.

Exotic metals are trophies of element collection

Ultra-rare scandium is Hammond's latest, hardest-to-get, and most expensive prize. This tiny bit cost him \$10. First pound of silvery metal was made as recently as 1960 for Air Force—which is interested in scandium because it's almost as lightweight an element as aluminum, and has a much higher melting point.



Quarter-pound of costly hafnium, in solid bar faced with silvery crystals, was handsome gift from a chemical company. Scarce metal is used for control rods of atomic-power reactors.

can aim at, less a few too radioactive or corrosive to have around.

Where do you find elements? Any home yields aluminum, copper, carbon, others. The corner drugstore has more. Next step is to a large scientific-supply house; one firm sells more than 40 elements. Then you're on your own and the real hunting and adventure begin.

Watching the news gave Hammond—by day, manager of technical publications and librarian for a Hartford firm—his collecting edge. Chemical journals told him of elements newly produced for atomic and space-age uses: exotic hafnium, scandium, rare-earth metals. Then came dealers' ads offering them for sale.

Hammond's queries bombarded suppliers. The problem: to get collector-size specimens, say a gram, within a \$10 limit he'd set. Some samples arrived as gifts. More often it took many tries to find dealers able and willing to fill such small orders. Thus came his "hard" ones.

His collection's cost: a modest \$250. Not only a classroom exhibit, it offers him rare materials for experiments—such as coating telescope mirrors with unusual metals. And it should usefully spread the news that so many elements can now be assembled and displayed. ■ ■

"I'd like to see them make..."

Spray poles triggered at bottom to operate an insecticide bomb held at the top. They'd put you on target for spraying caterpillar tents or wasp nests in trees or under house eaves.—S. Smith, New Augusta, Ind.



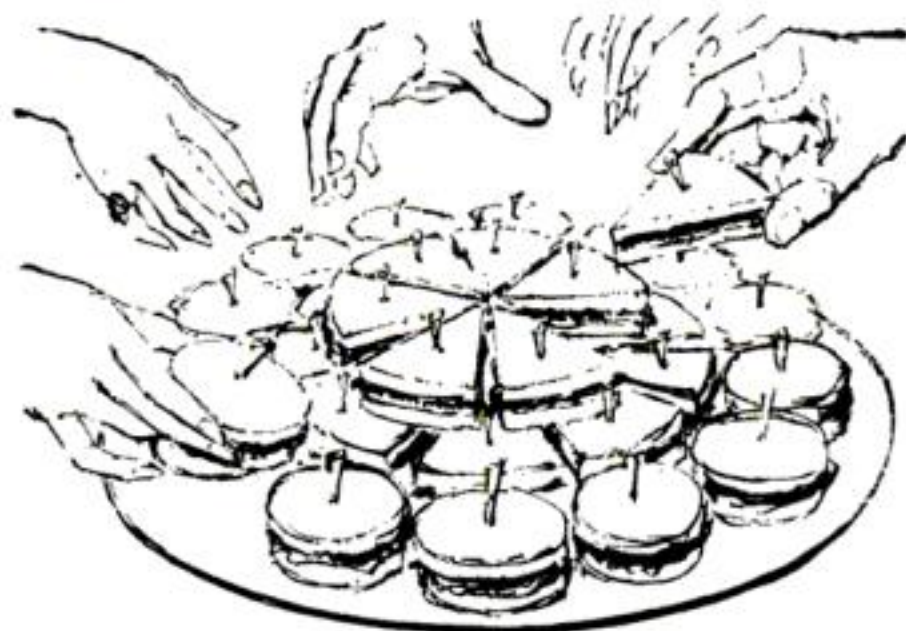
Rear-window air deflectors on station wagons to keep out gales, yet allow ventilation. The angle could be controllable by a dashboard switch.—John King, Ashkum, Ill.



Garden-edging blocks with long stakes precast in one side. Then you wouldn't have to dig a trench to keep them from getting kicked around the yard.—Dean Himmelreich, Milwaukee.



A shorten-at-will handlegrip on one side of power mowers so you could cut close to fences and other obstacles. It could telescope, screw in, or fold.—W. P. Twigg, Oak Lawn, Ill.



Edible "toothpicks"—spears of garlic-flavored pretzel stick or peppermint candy—for holding sandwiches together or serving hors d'oeuvres.—A. R. Dunham, Pasadena, Calif.

Everyone has his own pet idea of a gadget that he would like to see in general use. What's yours? We will pay \$5 for each one published. Please use Government postcards

only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 17. Write your name and address clearly. Contributions cannot be acknowledged or returned.

Like a ride in the sky? Try—

PARA-KITING



Getting ready for takeoff: Ground crewman adjusts kiter's harness. Arms, legs are free so kiter can take photos, even swim for exercise.



As towboat picks up speed, kiter steps forward and crewmen open chute to the wind. In seconds, the kite fills and carries rider aloft.



FRONT VIEW



REAR VIEW

Air flows through slots, creating low pressure above canopy while a high builds up below. Result is lifting power.

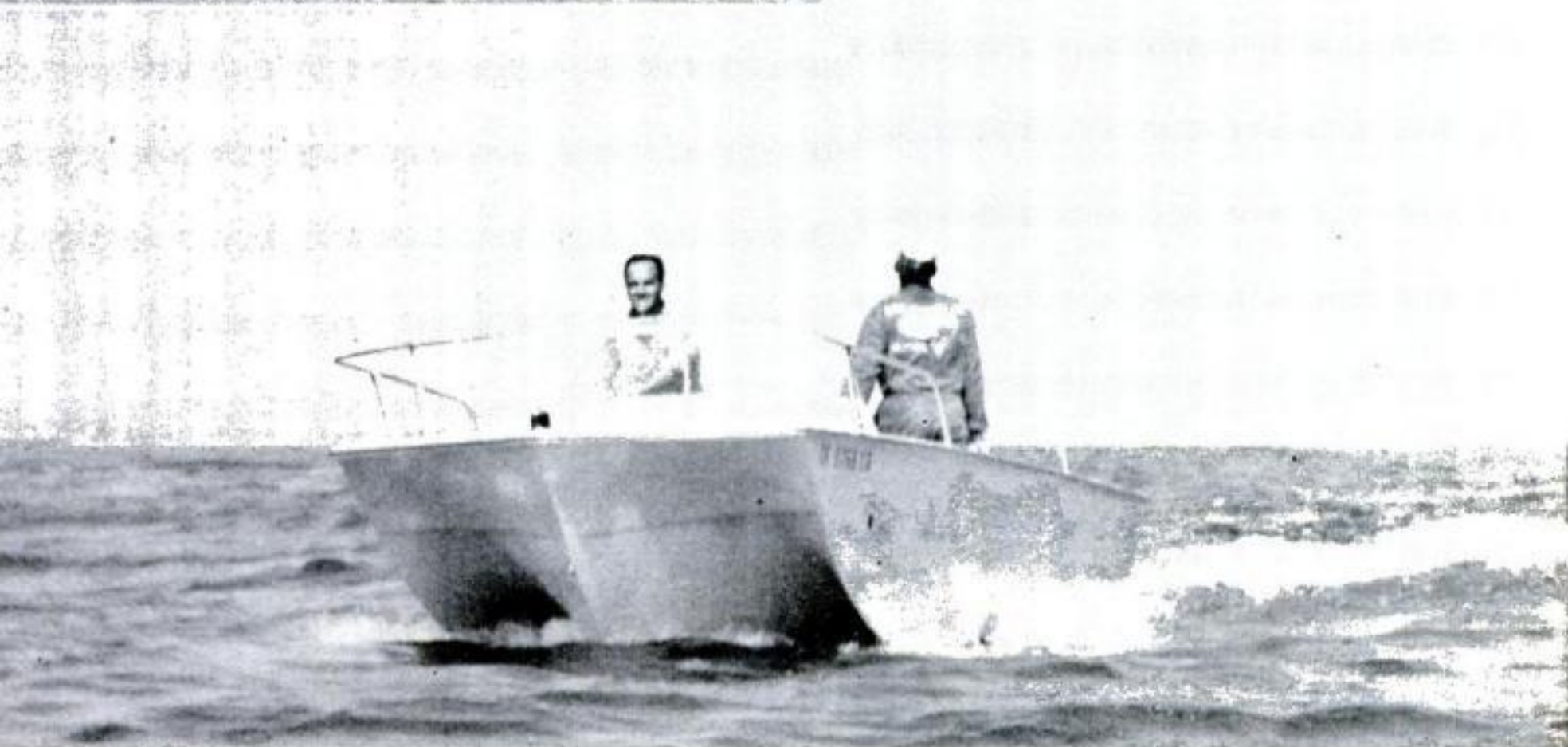
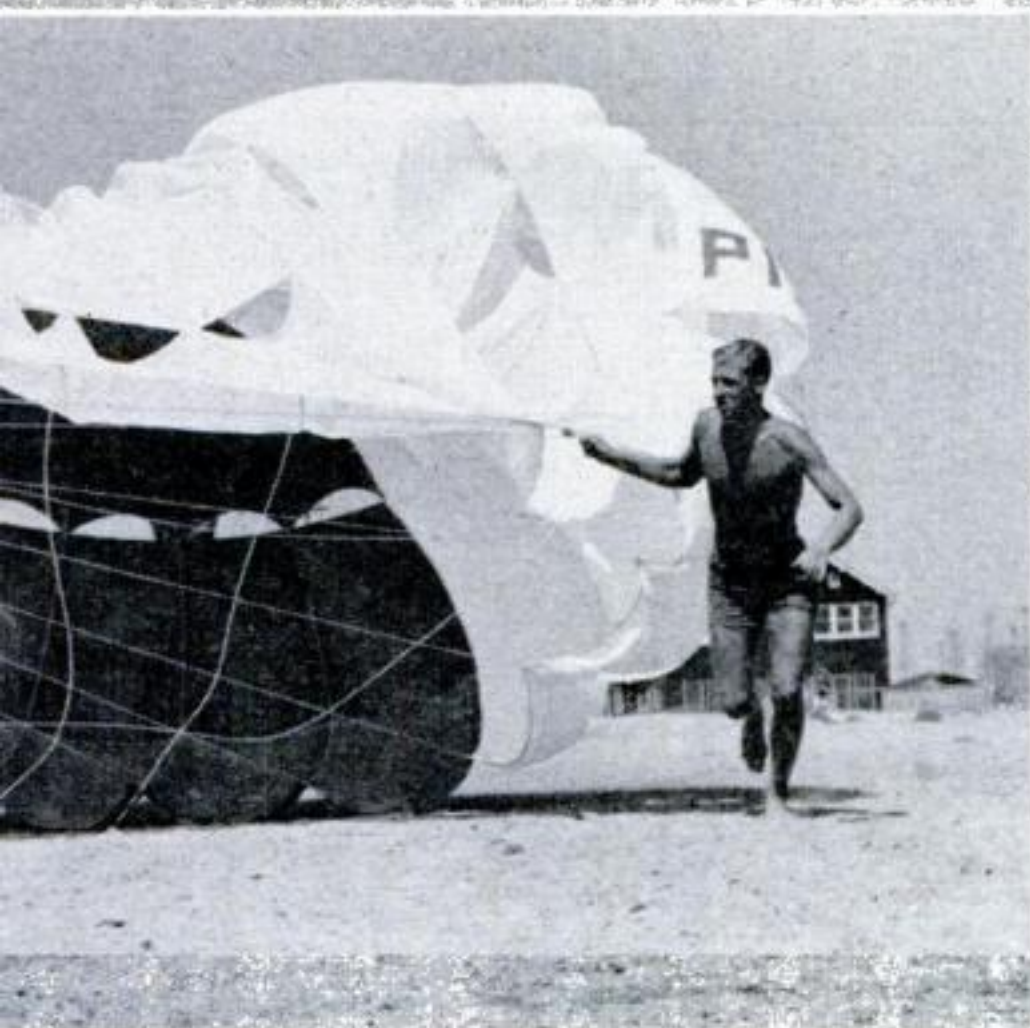
NOW you can get as high as a kite—literally. The kite is a chutelike canopy. Its string is a towline hitched to a moving car or boat. The result is para-kiting, a new sport that lets you soar hundreds of feet in the air and sets you down light as a feather. Besides the thrill of riding in the sky, enthusiasts say the sport is gentle: You can take aerial photos while aloft, then dip down for a swim. And safe: Cast off the towline or let it slacken, and you simply drift down.

Taking off requires some know-how. Here's how you manage it from water:

The boat is faced into the wind. You stand on the beach with the towline snapped to your shoulder harness. Trailing behind you is a 28-foot-diameter kite called a Para-Sail. A ground crew of two holds the kite up. As the boat accelerates, the towline pulls taut, and the kite starts to inflate. Now the kite's tricky design comes into play. The Para-Sail is perforated with several dozen slots. Air, spilling through these, creates a low-pressure area above. But there's a high-pressure area below. The result is aerodynamic lift, and you take off.

How high you fly depends on the towing speed—the slower the lower—and the length of the towline. A 300-foot line will let you rise about 200 feet.

Wind can be a nuisance if it gets above 15 m.p.h. or if there



is turbulence. Steady winds of five to ten m.p.h. are ideal. Although the boat (or car) must face into the wind on takeoff, it can veer as much as 45 degrees to left or right once the kite is up.

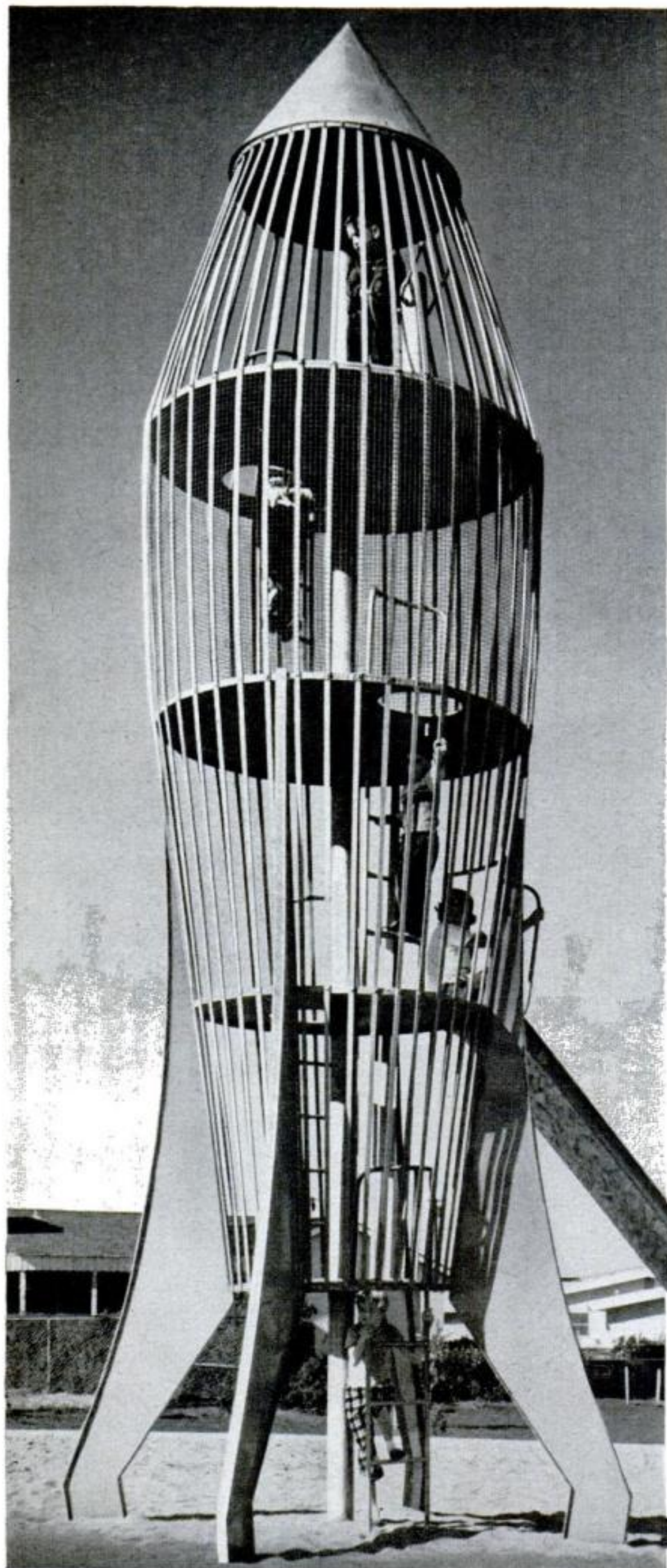
The Para-Sail is made by Pioneer Parachute Co., Manchester, Conn. The land version (kite, 300-foot dacron towline, and carrying bag) costs \$503.70 (f.o.b.). The same outfit, with a polypropylene line for water use, costs \$459.85.—*James Joseph.*

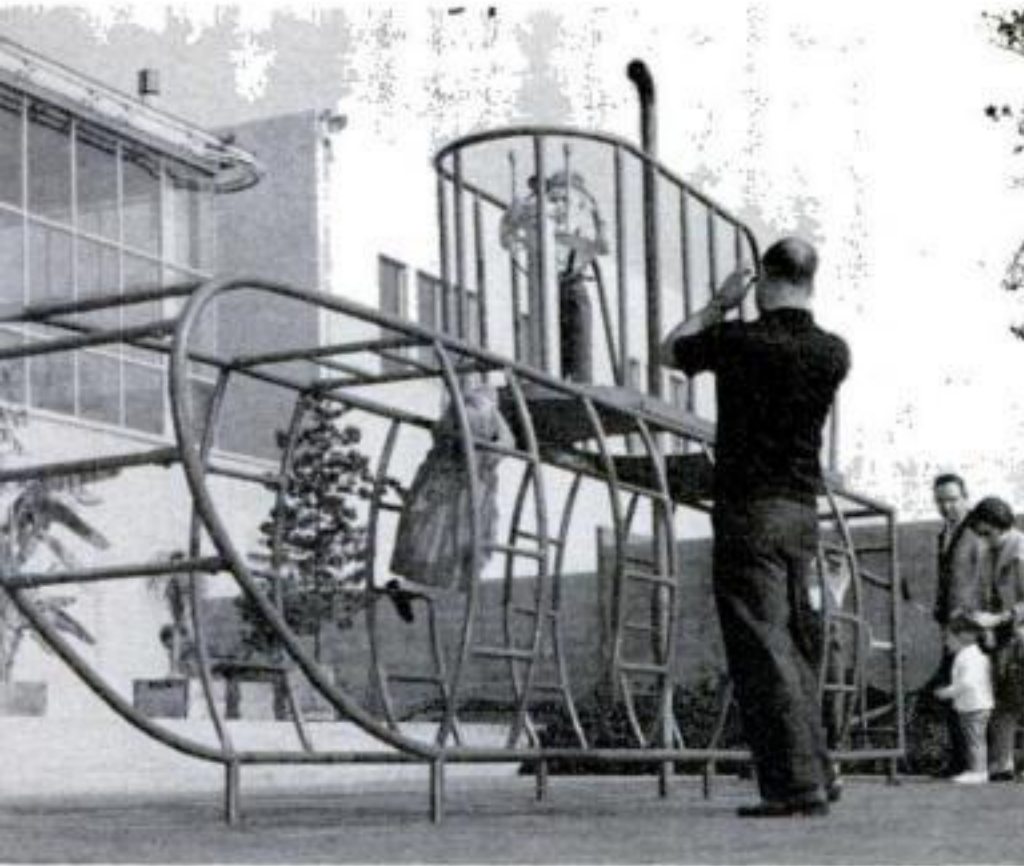
Kiter floats 200 feet in the sky at the end of 300-foot towline. A 50-hp. engine and 20 m.p.h. are sufficient for launching 225 pounds.

Space age comes to the playground



◀ Moon rocket, a 26-foot-tall newcomer to school and park playgrounds, lets kids climb and slide. It's held erect by four steel fins and a pole from nose cone to base. Four skid-proof decks are connected by ladders. Slide runs off to ground from the second "stage."





▲ **Atomic submarine** has wheel that turns, propeller that rotates, and periscope that doubles as sliding pole. Connecting ladders join bent-pipe port and starboard sides and extend over top. The frame is set in concrete.

◀ **Earth satellite** stays in orbit without rotating. Radial pipes in 10-foot-diameter Saturn-like ring provide climbing and swinging space. Equipment on these pages was made by Jamison Mfg. Co., Los Angeles.

Tradition has gone by the board in schoolyards and public playgrounds—old-fashioned swings, slides, and ladders are on the way out. Using new materials and imagination, equipment makers are turning out fanciful designs, geodesic patterns, space concepts, and modernistic forms that provide children with a world of up-dated make-believe as well as good exercise.

In addition to the things shown here—all basically of steel bars and pipe—there are sculptured-concrete play shapes, realistic plastic accessories, and a riot of airy objects made of pipe.

A climbing forest contains pipe trees with aluminum seats dotting their "limbs" for resting during a climb. Concrete stalactites look like the real thing, but are easier to get up on. Tots can climb inside a 12½-foot radar tower, work its controls, rotate its antenna, and escape via slide should a "missile" be sighted. A stage-coach and horses are made of pipe. A flying saucer is a space-age whirligig propelled and ridden by kids.

Play facades resembling those used in Hollywood movie sets are formed from concrete slabs to represent fire houses, forts, and stores. One fire house has climbing ladders and sliding poles behind it—and a realistic plastic fire hydrant in front.



Buoyant-foam bunkhouse takes to air, its 1,400 pounds an easy load for a copter.

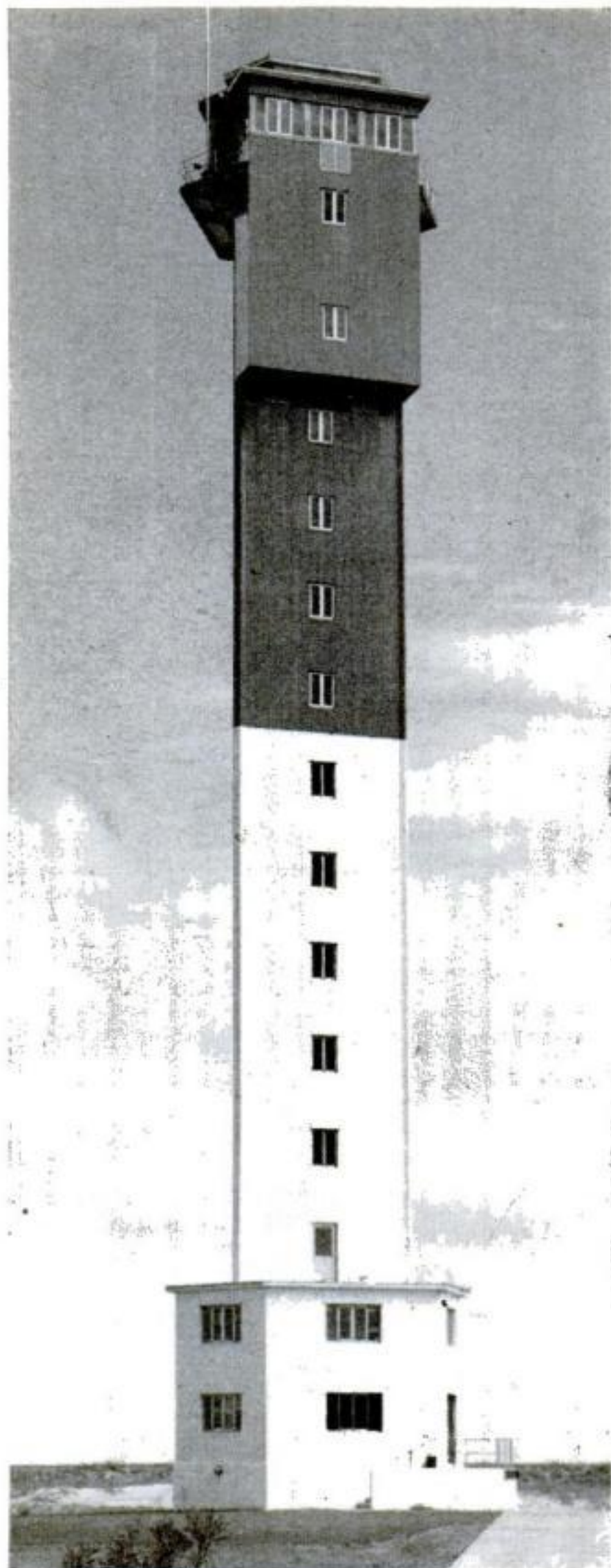
Flying bunkhouse gets fast ride

How would you get a bunkhouse for a logging crew into the woods without the high cost and delay of hauling materials over poor roads? A Canadian firm flies them out by helicopter.

Thermolite Plastics, Ltd., makes the bunkhouses of plastic foam and fiberglass in 10-by-24-foot units in its Vancouver plant, delivers them to the lake nearest the logging site. There they are hauled to shore, to finish the trip by trailer along road and trail.



Power boat tows bunkhouse ashore. Upside-down lettering is reflection in water.



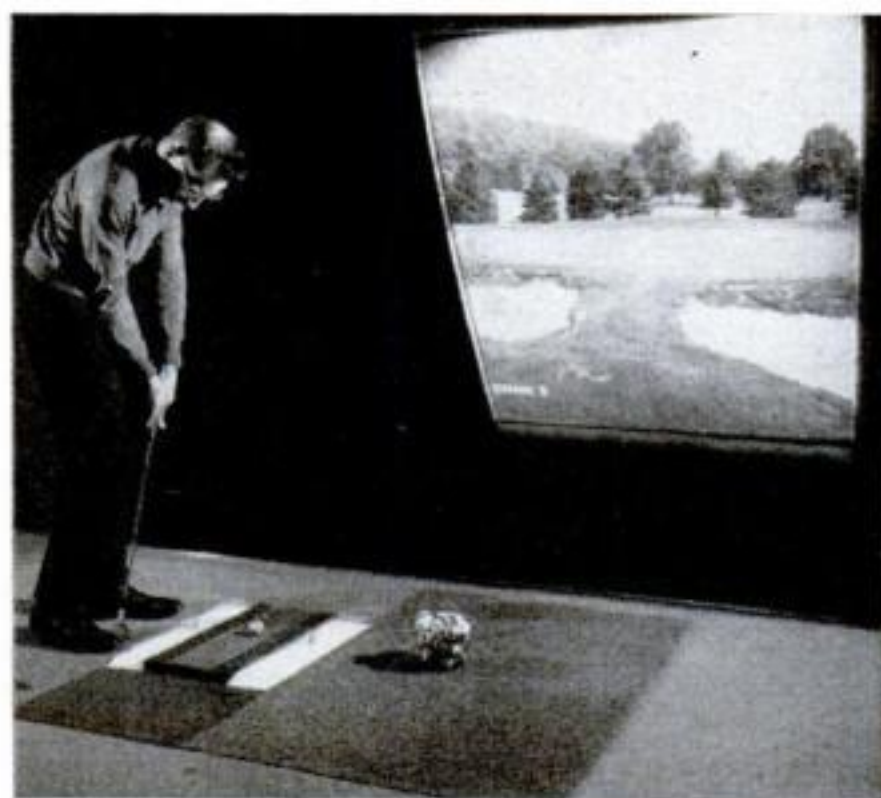
Lighthouse with 28 million candles

The new Charleston Light is triangular, stands 163 feet high, and, according to the Coast Guard, has the brightest light in this hemisphere—28 million candlepower—visible 19 miles out from the South Carolina coast. The red-and-white building is faced with corrosion-resistant porcelain-enameled aluminum and is said to be the first lighthouse to have an elevator.



High-speed amphibian for Marines

Rolling on land or planing at sea, the Marine Corps' new LVW (land vehicle, wheeled) can carry five tons of cargo at 35 m.p.h. with its 1,500-hp. gas-turbine engine at full throttle. The amphibian, shown above with wheels lowered for land travel, was designed by Borg-Warner's Ingersoll Kalamazoo Division for supplying beachheads from ships anchored 50 miles offshore. Its water range is 180 miles.



Indoor golf with outdoor view

A giant color picture of a fairway flashes on the backstop net above. The golfer swings, slams the ball into the net. A microphone picks up the sound and starts a computer, which works out where the shot would have gone and tells a Kodak projector which of 80 scenes to project next. First Golf-O-Tron course, it's made by S & M Products, NYC, and is in Worcester, Mass.

PS ELECTRONICS



TAPE CHANGER

...It's Here at Last

It'll thread, play, and rewind tapes automatically—giving up to 15 hours of stereo music

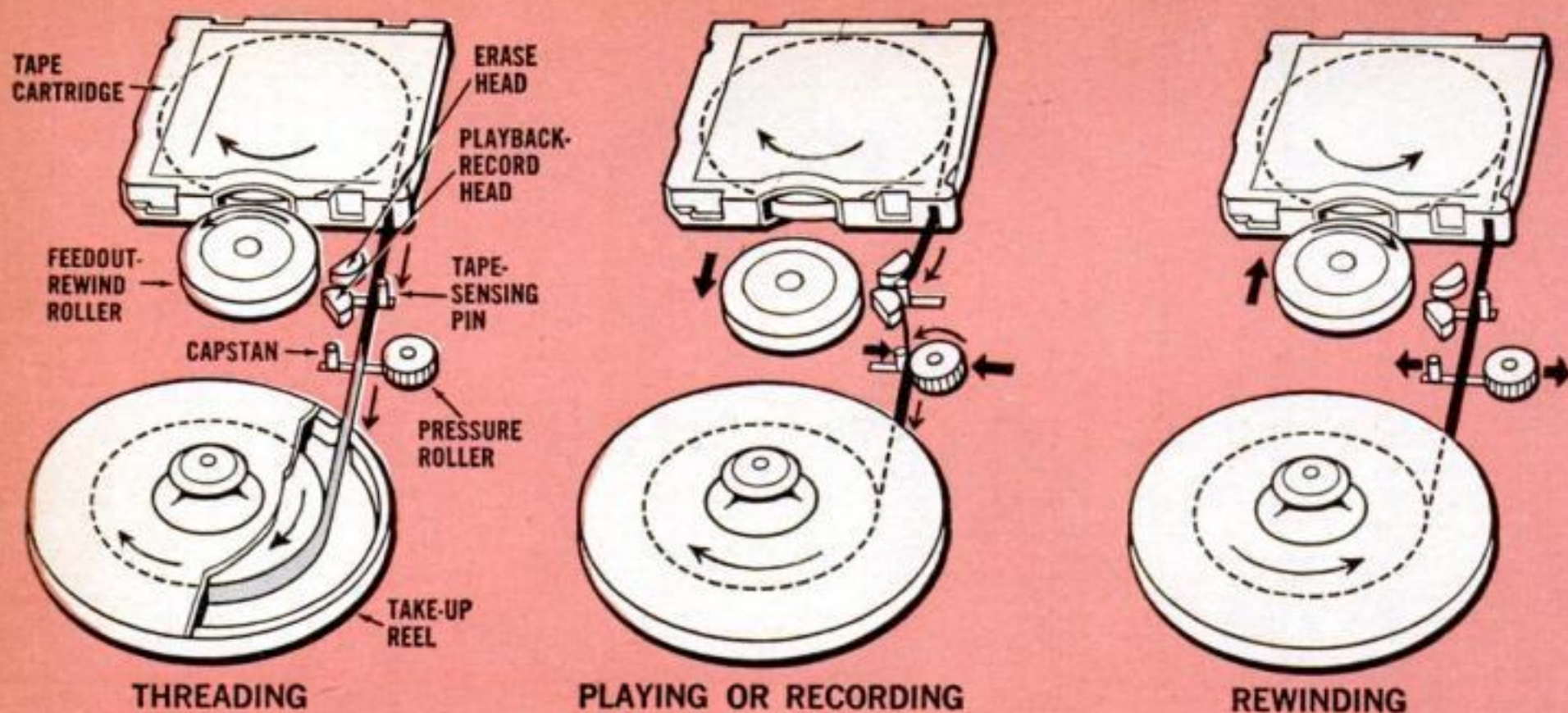
By Charles S. Tepfer

HERE'S a tape machine that might just wean home music listeners away from records. It matches or exceeds record-playing systems in every aspect of convenience and foolproof operation. It will:

- Play up to 15 hours of stereo music without attention. Individual selections can be of any length (up to 45 minutes) and played in any sequence you choose.
- Thread the tape and handle the reels

CONTINUED

91



How tapes are threaded, played, and rewound

Feedout-rewind roller presses against the reel, exposed through a half-moon notch, and rolls out a stiff, $\frac{1}{4}$ "-wide tape leader through a slit. The leader slides along a channel between capstan and pinch rollers and onto the take-up reel. Spring-loaded flanges grip edges of leader, and the tape starts winding onto take-up reel. Tape-sensing pin pushes tape against erase and play-

back-record heads, and the pinch roller presses tape against capstan. At the end of the reel, tension on the tape triggers the rewind cycle and the tape is whisked back into the cartridge.



How tape cartridges are changed automatically

Tape cartridges to be played are placed on a platform in a well at the rear of the machine. Up to 20 plastic cartridges, $3\frac{3}{4}$ " by $3\frac{1}{4}$ " by $\frac{1}{2}$ ", can be stacked at one time. Press two piano-like keys and the system starts—tape is automatically threaded, plays 45 minutes of stereo music, and, when the end of the tape is reached, automatically rewinds. Cartridge is rejected and a new one falls into playing position. Selection can be rejected at any time by pushing reject lever, or machine can be set to repeat indefinitely.



Tape-cartridge well above shows a single cartridge in playing position. Feedout roller is at top, projecting into half-moon notch.

automatically. Also, it is simpler to load than an automatic record changer.

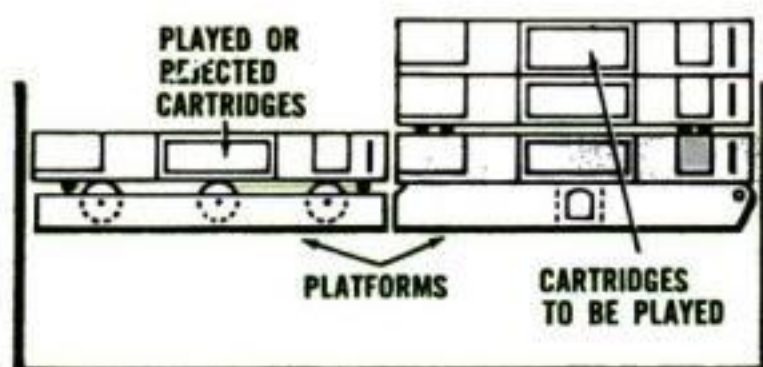
- Shrug off careless handling. Simply turning a dial fixes a jam.

- Make live recordings as easily as it plays prerecorded tapes. You can make your own recordings from radio, TV, or records.

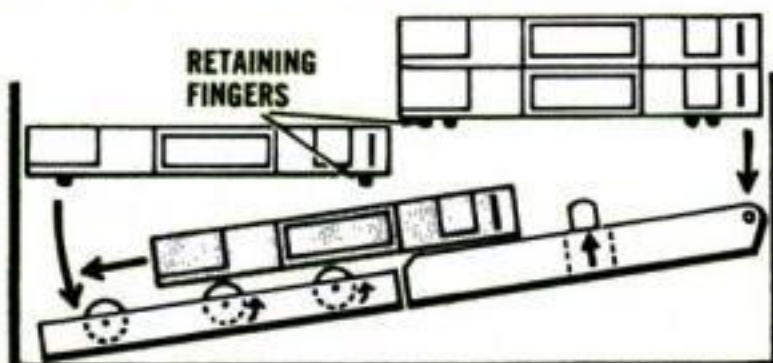
That giant tape maker, Minnesota Mining and Mfg. Co. (3M), put up the millions to develop the recorder, and is producing it in its Revere plant.

Many people, enchanted with the idea of a tape recorder, have bought them. But recorders have rarely been put to full use except by a few dedicated hobbyists. If there is ever to be a huge home market for magnetic tape, 3M reasoned, there would have to be a machine so easy to use that even women would like it.

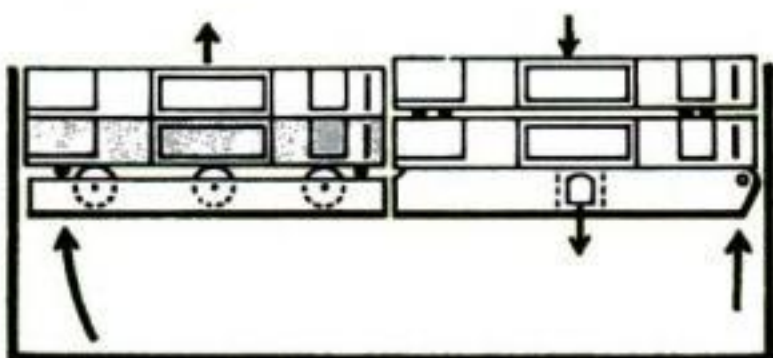
So about five years ago, they asked the man who developed the $33\frac{1}{3}$ LP record,



Shaded cartridge is in playing position with subsequent ones on top. A reject is at left. (View is from rear.)



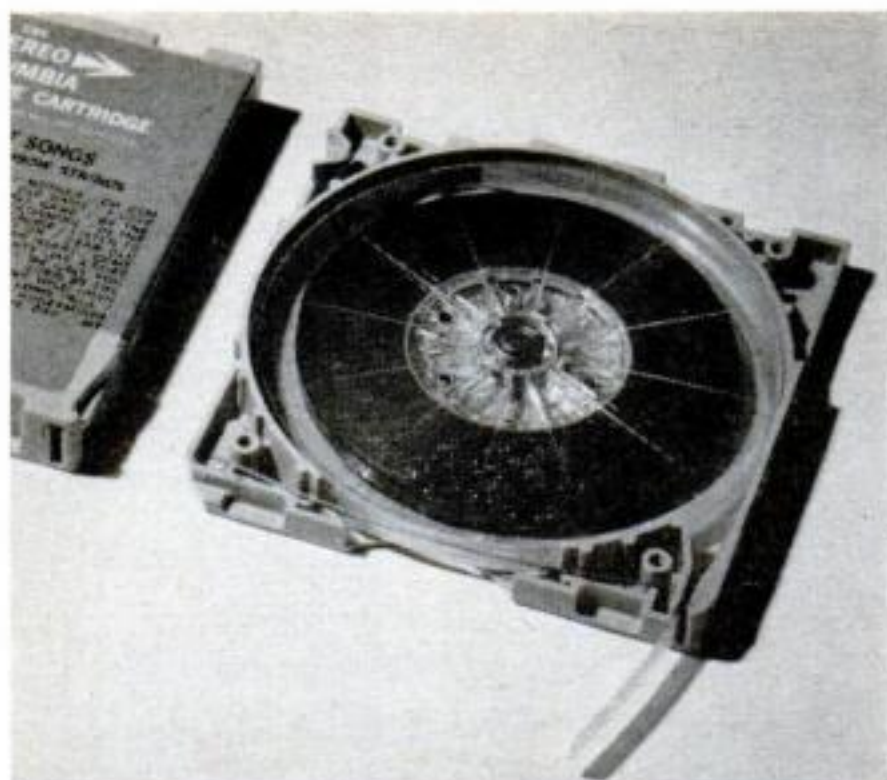
When changing cartridges, fingers project to support stacks, while platforms tilt to slide cartridge under reject stack.



Platforms rise to push cartridge above retaining fingers on reject stack, release next cartridge, and lower it into position.

Dr. Peter Goldmark of CBS Laboratories, to design a convenient tape system. The result, first shown at the Engineers Show in New York City in March, 1960, was an automatic tape changer. Talking about that model, one 3M executive admitted, "We would have had to put a list price of \$2,000 on the system, since it would have been necessary to hand-produce each unit." But Dr. Goldmark had come up with the answers to the problems that had made tape changers for the home impractical. What were these problems? Tape speed and noise.

Tape speed. In conventional high-fidelity tape recorders, $7\frac{1}{2}$ inches of music-magnetized tape moves past the playback head per second. It takes some 1,500 feet of tape to produce 40 minutes of music, about the same as on an average LP record. A seven-inch reel of prerecorded tape contains about 1,000 feet for four-track stereo—the



Looking into a tape cartridge: Stiff plastic leader is coiled around inside the case but outside flanges of tape reel. Actual recording tape is narrower than leader—about $5/32$ ".



Panel on the back has plug-in provisions for almost any mode of operation you might want: microphone recording, recording from radio, output to external speakers or amplifiers.

tape runs through first in one direction, and then the reels are reversed and the tape runs back, like 8mm movie film. This gives 2,000 feet of music. But packing 1,000 feet of tape into a cartridge makes for a bulky package and an even bulkier machine to handle it.

Goldmark's solution was to reduce tape speed to $1\frac{1}{2}$ inches per second (i.p.s.). At this speed, 450 feet of tape would play for 48 minutes, and that much one-mil-thick plastic tape can be wound on a three inch reel. The tape is narrower, too: $\frac{5}{32}$ inch wide versus the conventional $\frac{1}{4}$ inch.

While some other recorders run at this speed, and some even half as slow, the fidelity is poor. The slower the speed, the less tape passing by the gap in the recording head per second, leaving less room for the thousands of tape particle magnets needed for 10,000 cycles per second and higher. Goldmark solved this by decreasing

the size of the recording-head gap, making the magnets smaller. The gap between north and south poles is only $1\frac{1}{2}$ microns, or 60 millionths of an inch ($1/50$ the diameter of a human hair); other recorders have a gap of $2\frac{1}{2}$ to 6 microns.

The noise problem. At slow speed, increased noise was a little harder to beat. The needlelike magnetic particles on the tape do not all line up in proper direction, and the strays cause noise. Experts long held that for high-quality tapes, $7\frac{1}{2}$ i.p.s. was the slowest speed at which background noise could be held down.

Goldmark called for, and 3M delivered, a new kind of tape with finer magnetic particles, and a better binder to hold them to the plastic backing for greater uniformity. This tape, called "270," has a signal-to-noise ratio twice that of other tapes; even the weakest high-frequency sounds will not be blanketed by tape hiss.

The mechanism. Developing the changer seemed something of an anticlimax after the initial problems of tape speed and noise were solved. Still, the mechanism is ingenious. Although the machine is touted as opposed to the reel-to-reel concept, it does in fact operate with two reels: One, the feed reel from which the tape unwinds, is in the cartridge; the other, the take-up reel, is permanently in the machine. As in the automatic record changer, no timing mechanism is used: A system of tape-sensing elements and cams controls each step in the changing and playing cycle.

The Revere automatic tape changer (to be available nationally by late summer) is an all-in-one unit with two amplifiers and two speakers. It's a heavily portable 32 pounds, about the same weight as a 16-inch TV, but not as bulky. A deck version (changer plus preamplifiers only) for addition to stereo systems is promised.

The machine handles as easily for recording as for playback. Merely connect the two mikes, or cables from the FM set, TV, or whatever, to sockets on the back. Then place a cartridge of "raw" tape in the well and press down the "record" key.

If playback and recording sound easy, it's because the machine does all the work. It must:

- Lower the cartridge into the playing position.
- Nudge the leader out of the cartridge and onto the take-up reel.

[Continued on page 184]

SHOP TALK

By Sheldon M. Gallagher



The right way to use a wrench: Try this trick on your friends



Readers ask us from time to time how come it's important to turn an adjustable wrench toward the movable jaw rather than away from it. Here's a simple trick you can use to prove the answer to yourself and friends: Take a hexagonal pencil and grasp it between your thumb and forefinger, as at left. Your thumb represents the wrench's movable jaw and your finger the fixed jaw. With your other hand, turn the pencil counterclockwise—the same as turning the wrench clockwise. Note how the pencil rolls your thumb inward and is easy to hold.

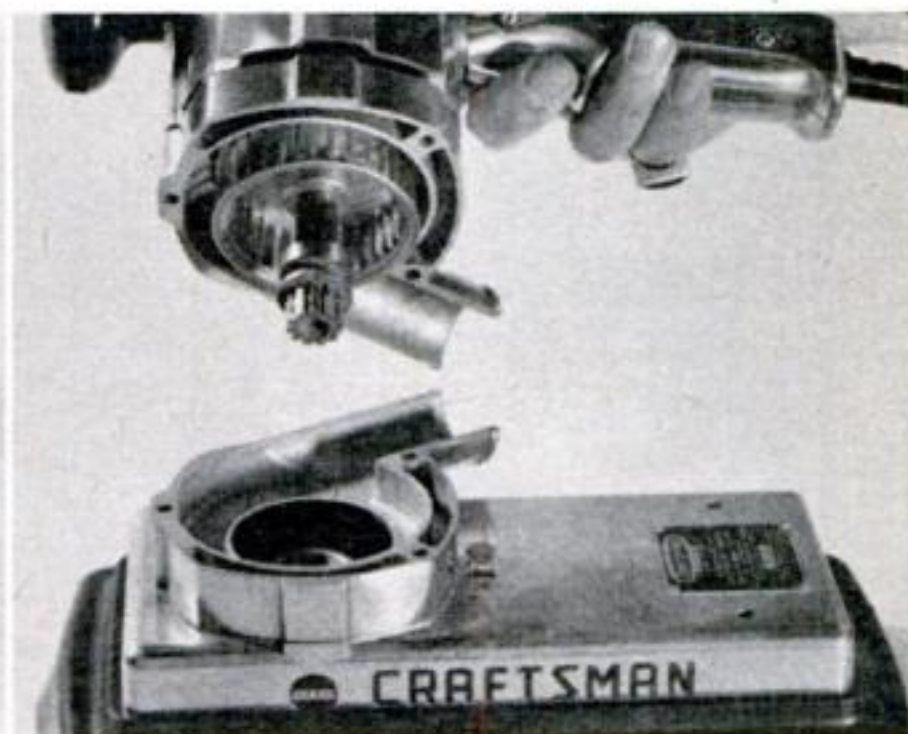
Now turn the pencil clockwise—the same as moving the wrench counterclockwise. Note how it rolls your thumb outward, twisting out of your grasp. The same thing happens with a wrench turned backward—the nut tends to twist out and puts the strain on the movable jaw, the weakest part. Properly used, a wrench puts the strain on the fixed jaw.

How good are dustless sanders? Here's a surprise

We got to wondering the other day just how much sanding dust the new dustless sanders really pick up. These are the things with little bags that look like miniature vacuum cleaners.

We borrowed a Sears Craftsman, one of several on the market, and put it to work on soft pine with 120-grit paper. After 15 minutes, we checked the bag to see if it had collected anything. What poured out is shown below at left—enough to fill an eight-ounce measuring cup. Multiply this by several hours of sanding and you can see just how much dust *doesn't* get into your shop.

The secret is a high-speed blower on the motor shaft (below, right) that whirls up a strong sucking action inside a skirt surrounding the sanding pad. Some sanders have an outlet, instead of the blower, to which you attach a vacuum cleaner.

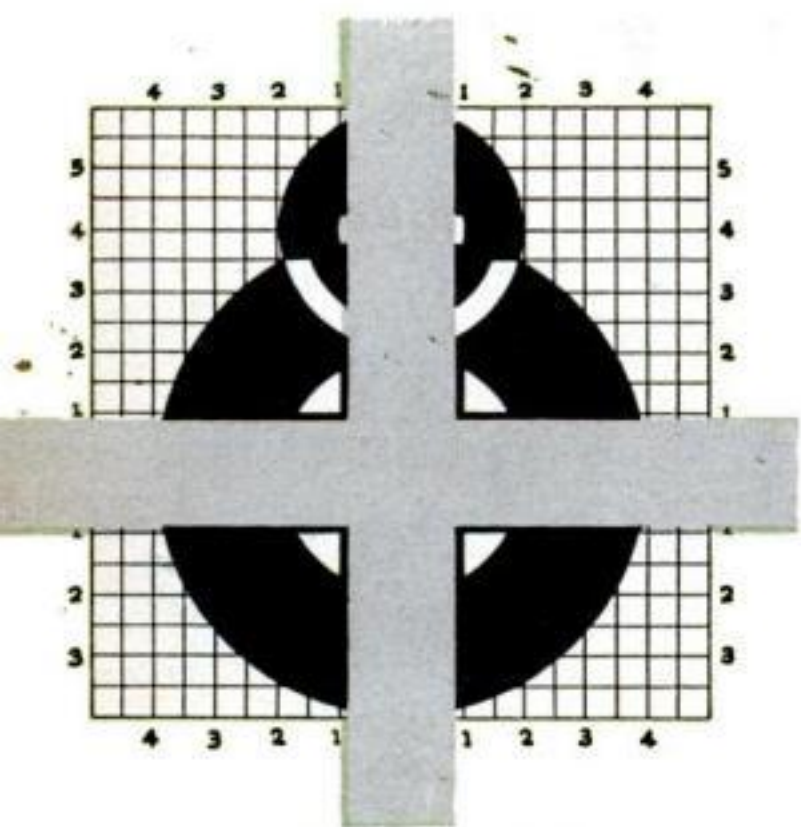


New 2-Eyed Target Sharpens

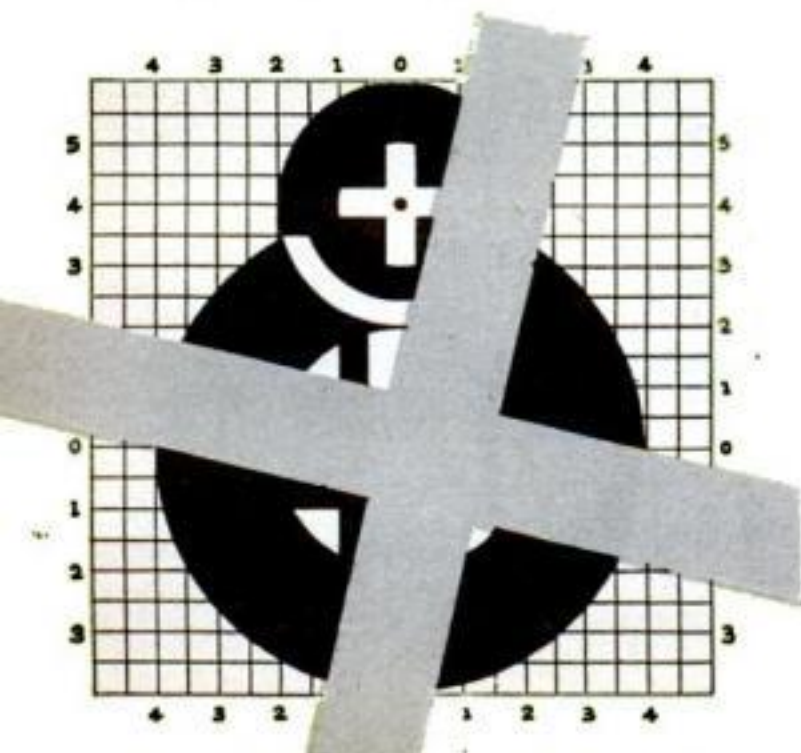
By Don Shiner

WANDER out to a shooting range this summer and you're likely to see a strange new target with not one, but two, bull's-eyes. It was devised by Jay Gallagher, a New England sportsman who got tired of shooting at a conventional single bull's-eye that you weren't supposed to hit anyway.

The problem, a familiar one to sharpshooters, goes like this: For hunting, your sights are adjusted for long range, say 300 to 400 yards. When you switch to target practice at, say, 100 yards, your shots are actually 3" to 4" above your line of aim to

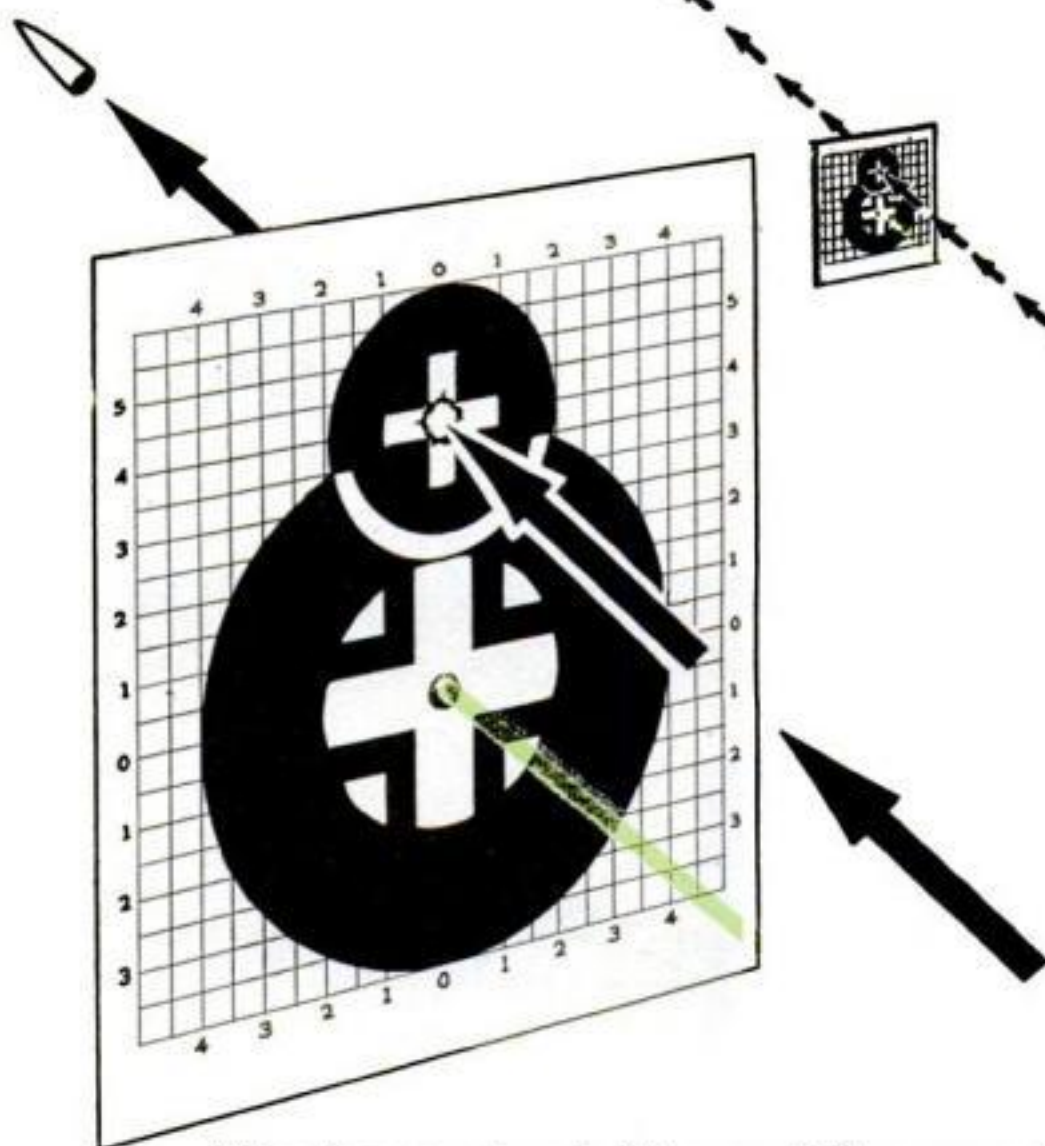


When you're on target, your scope cross hairs blot out the white cross, as above, leaving four white specks at the corners. So long as you see all four specks, you know you're perfectly lined up. If cross hairs tilt, as below, they cover up one or more of the specks, and you know you're off target. Note how upper right-hand speck has completely disappeared.



LINE OF AIM

BULLET'S TRAJECTORY



Why there are two bull's-eyes: When your rifle is sighted in for long range, and you wish to check it at close range (for convenience), your shots hit high on a conventional target. On the new target, you aim at the lower bull's-eye, but your shots strike the upper bull's-eye if you've sighted and fired correctly. Surrounding grid of $\frac{1}{2}$ " squares tells you how much you're off.

Your Aim

allow for their drop in trajectory. So you miss the bull's-eye.

Gallagher's two-eyed target is designed to give you something to aim at and also something to hit, to make rifle sighting easier and more accurate. You aim at a large 8" bull at the bottom, and your shots land in a smaller 4" bull at the top. A grid of $\frac{1}{2}$ " squares helps you plot exactly where your shots are falling. When they strike perfectly in the upper bull, you know you're correctly sighted.

Gallagher also found that the cross hairs of his scope sight tended to get lost against the black background of conventional targets. To overcome this, he made the center of his bulls a white cross. When your cross hairs are properly lined up, they fill the white cross, and you know you're on target.

The cross in the lower bull is designed for scopes of three or four power. With higher-power scopes, the cross hairs fit too loosely inside it. In this case, you turn the target upside down and sight on the narrower cross in the small bull, using the big bull as your upper target. The two bulls are 4" apart—the proper distance when you're sighted 4" high. For other ranges, you can use the grid locations to determine the correct height.

The new target has been tested by the U. S. Ordnance Dept. and has been used by the Canadian Army to help sharpen up the aim of its snipers. Copies are available from Jay Gallagher, 23 Pleasant St., Keene, N. H. Price: \$1 a dozen.



Let It Fall! Let It Fall! whatever it is

REFLEX acts can sometimes get you into trouble, as Tom Sawyer learned so well long ago. Toss a coin into a man's lap and he'll automatically knock his knees together to catch it. But try it on a woman, and she'll react in exactly the opposite way.

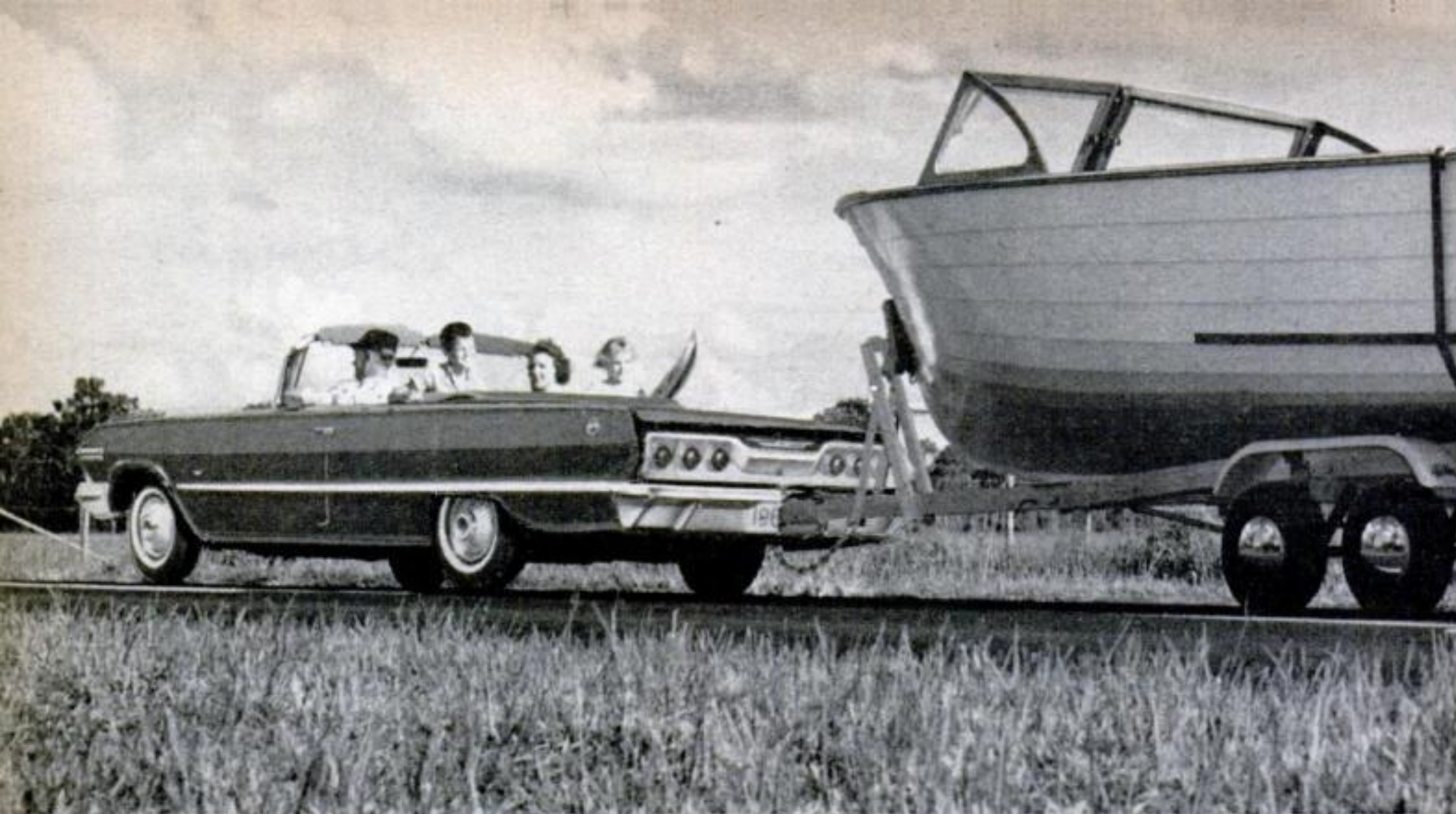
Safety experts have discovered that in shop and factory there's one reflex action that can lead to trouble: the instinct to try to catch a falling object.

A machinist sees a lathe chuck slide off the bench—and instinctively sticks his foot under it to break its fall.

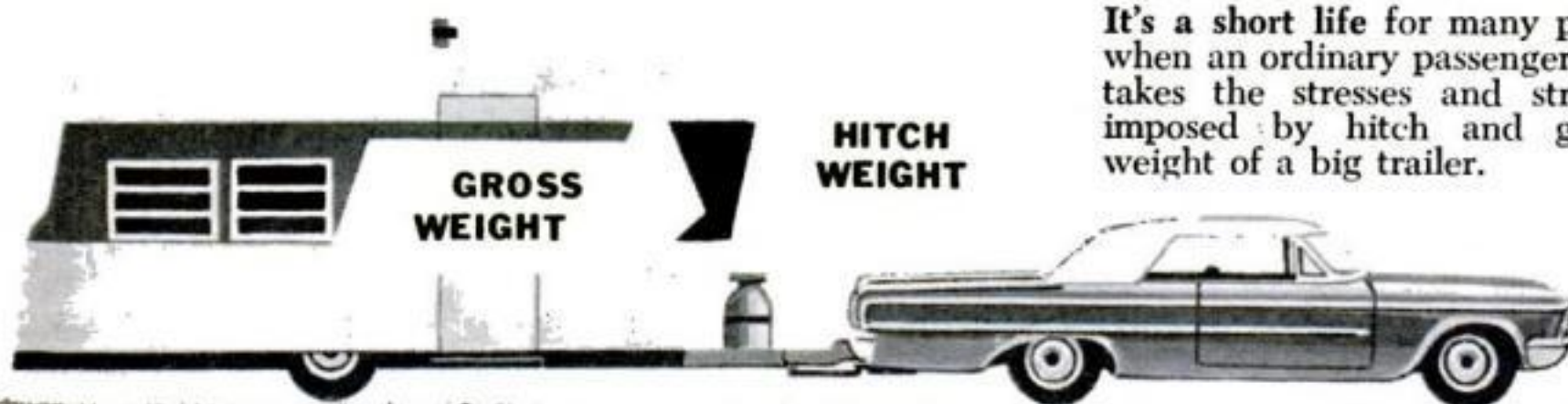
A worker on a TV production line puts down his soldering iron carelessly. It rolls to the edge of the bench and falls. He grabs, catching it by the 800-degree tip.

An amateur photographer, handling a bottle in his darkroom with wet hands, catches it as it falls and shatters against

[Continued on page 158]



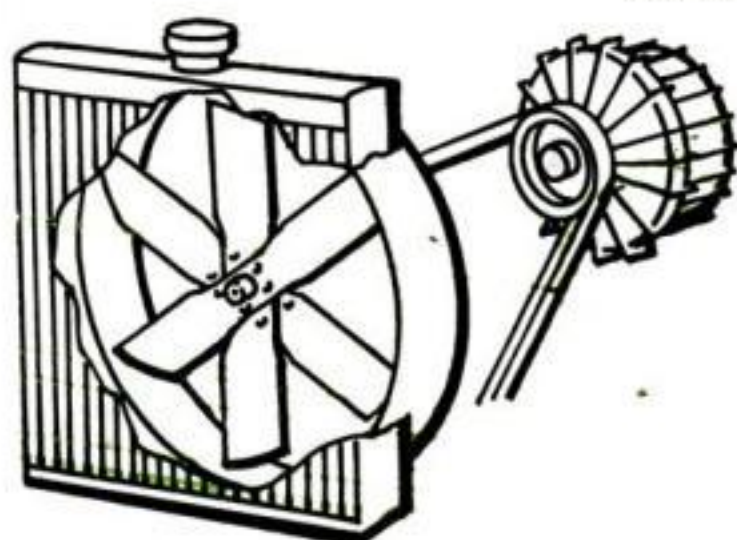
Little extras that beef up a car for towing save you big



It's a short life for many parts when an ordinary passenger car takes the stresses and strains imposed by hitch and gross weight of a big trailer.

Special equipment installed at factory when you buy a new car is the least expensive way to prepare for trailer towing. One maker says it will cost you only \$50 extra. Some of the special equipment that various U.S. auto makers now offer is shown in the sketch.

**HIGH-CAPACITY
COOLING SYSTEM**



**HEAVY-DUTY BATTERY
AND ALTERNATOR**



**POLICE-TYPE
BRAKES**

Now: Cars Made to Order for Trailer Towing

money in wear and trouble

The lowdown on those special options that help fit passenger vehicles to work-horse jobs

By V. Lee Oertle

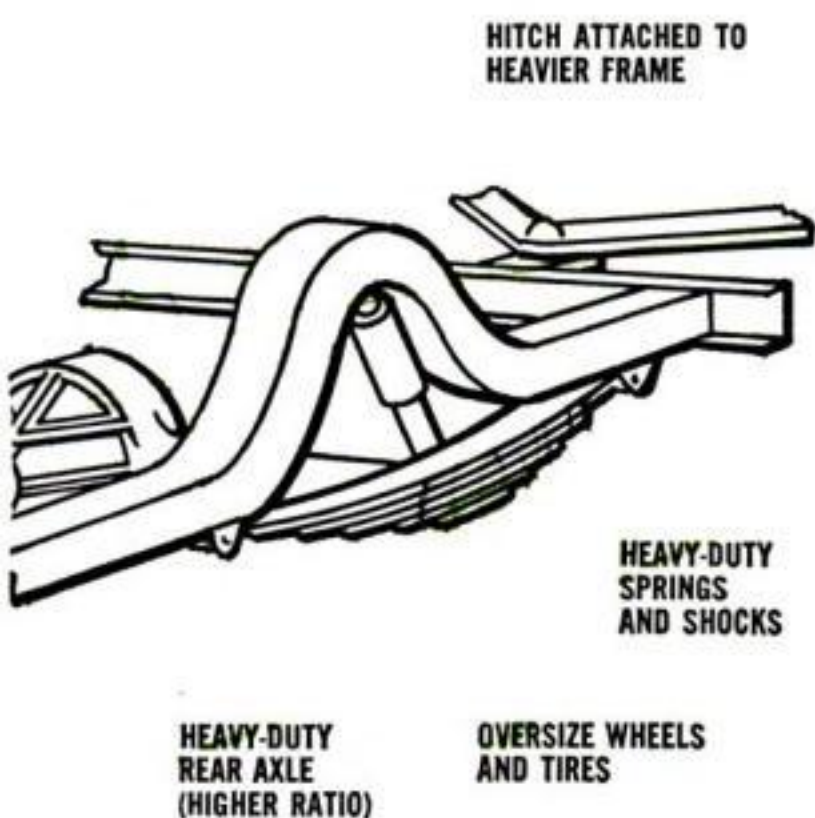
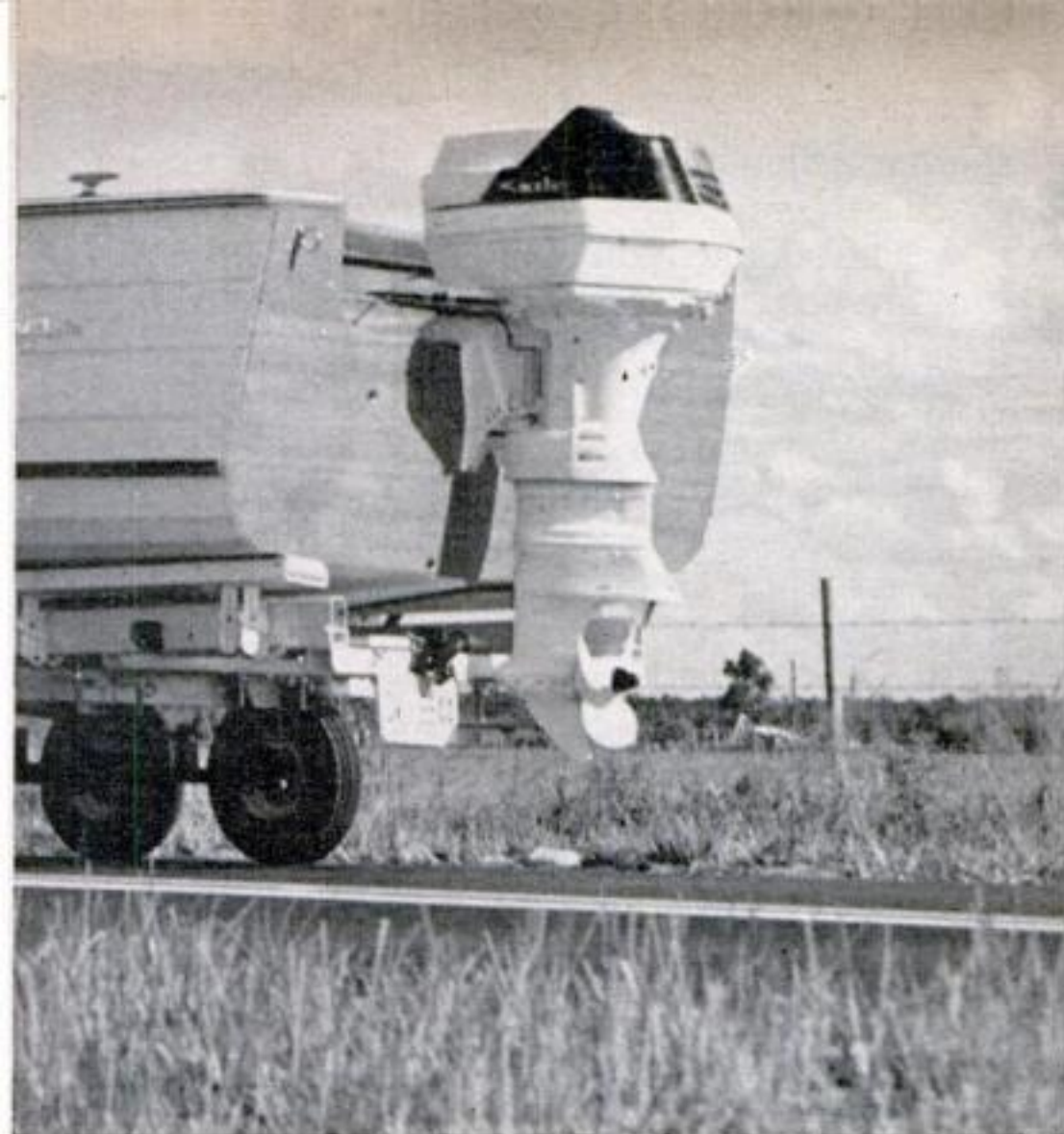
PLANNING to buy a vacation trailer? Or a new car to tow a trailer you already own? You'll want to know, then, that Detroit now offers various options that enable you to buy a car better fitted to the strenuous job of towing a vehicle weighing a ton or more.

This is a real switch. Only a few years ago a leading automotive engineer, questioned about trailer towing, snapped: "We build *passenger* cars—not *tow* cars."

A change in attitude began in late 1961 when Ford and Pontiac announced factory-installed equipment for trailer towing. Since then, the list has grown to five major manufacturers representing 12 more makes: Mercury, Tempest, Oldsmobile, F-85, Plymouth, Dodge, Valiant, Chrysler, Imperial, Rambler, Ambassador, and American. Buick puts out a bulletin listing recommendations for overload springs.

CONTINUED

99



HITCH ATTACHED TO
HEAVIER FRAME

HEAVY-DUTY
SPRINGS
AND SHOCKS

HEAVY-DUTY
REAR AXLE
(HIGHER RATIO)

OVERSIZE WHEELS
AND TIRES

Want to know more about towing options?

If you'd like further information about trailer-towing options available from Detroit, new-car dealers in your vicinity can probably help. Or you can write to:

American Motors Corp., Detroit (for Rambler, Ambassador, American).

Chrysler Corp., Detroit (for Valiant, Plymouth, Dodge, Chrysler, Imperial).

Ford Motor Co., Dearborn, Mich. (for Ford, Mercury).

Oldsmobile Division, General Motors, Lansing, Mich. (for Olds, F-85).

Pontiac Division, GM, Pontiac, Mich. (for Pontiac, Tempest).

.....

Today's trailer buyer wants to haul maximum loads up steep grades. That means converting his passenger car into a towing vehicle. There's a great difference.

As one Detroit engineer summed it up: "When a trailer is attached to the rear of a car, the car is changed from a load-carrying vehicle to a load-pulling vehicle. The demands of this type of operation are very different from those for which the car was designed. They present problems in spring and tire loading, braking, cooling, lighting, steering, and in operating economy."

Towing toll. When you drop a relatively light 200 pounds of trailer-tongue weight on the rear bumper of a passenger car, annoying things happen. The rear end droops, headlights aim skyward, steering response gets sloppy. That 200 pounds is equal to 600 or 800 pounds in the back seat.

Inertia must be counted in, too. When the car accelerates, the trailer wants to stand still. When the car and trailer are in motion and brakes are applied, the trailer wants to keep going.

Without special towing equipment, the tow-car driver can expect some of the following:

- Tires will wear 25 to 50 percent faster.
- Springs and shock absorbers will succumb early—perhaps in 5,000 miles of towing.
- The overworked electrical system will

shorten generator and battery life as much as 25 percent.

- The engine will overheat frequently.

What about the basic car? Experts seem to agree that a compact car isn't ideal for towing. If you must use one, select the highest horsepower available. With the smallest cars, don't plan to pull a trailer weighing more than two-thirds of the car weight. With standard-size cars, trailer weight should not exceed the gross weight of the car itself. If your car weighs 4,000 pounds, the trailer limit is also 4,000.

Special towing equipment isn't expensive if you consider it in relation to possible savings through increased life of the components. You save most by ordering at the time you order the car. Ordering equipment piecemeal, later, tacks on a labor charge for exchanging each item.

Pontiac has advertised that almost \$400 worth of special equipment can be obtained for less than \$50 if it's factory-installed. This situation is bound to spread.

Here is a summary of the car makers' recommendations and options:

Heavy-duty frames. Pontiac and Oldsmobile offer extra-heavy frames for about \$25, factory-installed. Such frames are standard on convertibles and wagons. The heavier frame allows a sturdier hitch.

Car makers condemn the bumper hitch for towing. You should have a rugged steel hitch bolted to the side frame, not merely to one rear cross member.

Special load-leveling hitches (equalizer types) are available, and are recommended by most manufacturers. These distribute weight evenly on the trailer axle, and on the front and rear axles of the tow car.

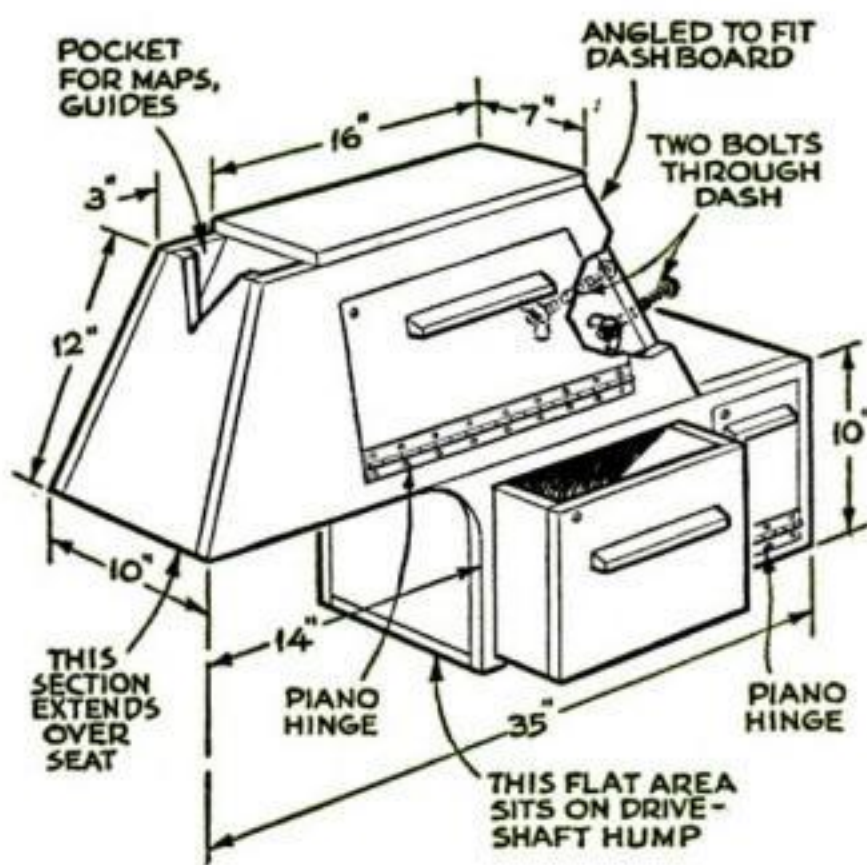
Engines. All manufacturers recommend higher-performance engines. Where a V-8 is available, choose it over a six or four. Boiled down to essentials, the message from Detroit on engine power goes like this: A big engine loafing will last longer than a small engine straining—and it'll do a better job of towing.

Transmissions. Almost without exception, auto makers recommend an automatic transmission for towing. Automatics shift at the right time, avoid engine lugging and overheating, and help the driver get over steep grades without fumbling with a clutch and gearshift.

If you insist on a manual shift, select a heavy-duty clutch of larger diameter. Four-

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For your car: A Homemade Travel Console



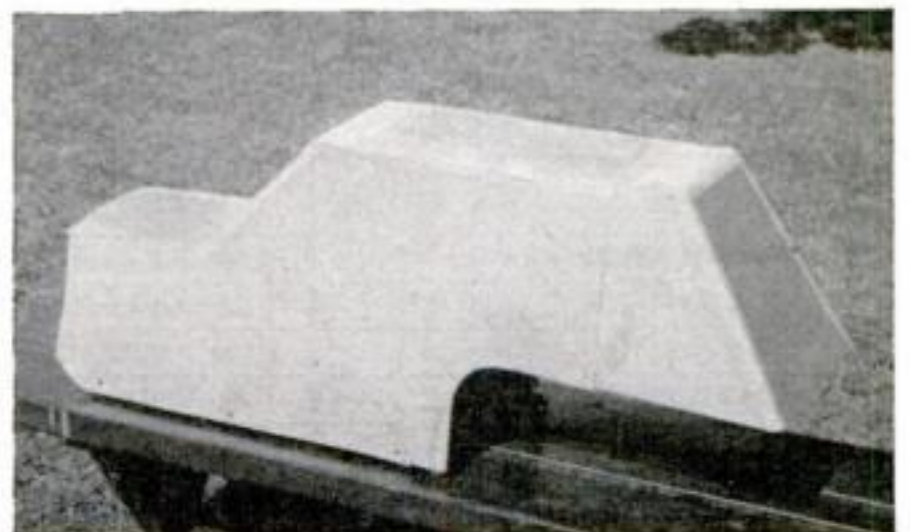
THE man who built the original of this car console calls it a trip organizer. And it does indeed work that way. His photographic and travel items are right where he or the front-seat passenger can reach them whenever desired—and not riding loose around the car or packed away in the luggage compartment or a suitcase.

William K. Northrup of Cleveland recommends that you first make a cardboard mockup as he did in designing the original. That way you can fit it exactly to your car.

Half-inch plywood will serve for the two separate assemblies. The rectangular box that rests on the drive-shaft hump has a drawer and a hinged-door compartment. The inverted hopper-shaped part above has a single door for access to several compartments. Bolts with wingnuts through the dash from the rear lock the console to the car.



Compartments all have locks to safeguard stored items while you're away from the car.



Cardboard mockup is a wise first step toward shaping and fitting console to your own car.



How you can tell one pry bar from another

TOOL	PURPOSE	COMMON SIZE	TYPICAL PRICE
1. CROWBAR	Heavy-duty prying, lifting, wrecking, concrete breaking	4' (14 lb.)	\$6.50
2. GOOSENECK RIPPING BAR	Wrecking, prying, heavy nail pulling	36"	\$2.00
3. NAIL CLAW	Driving under sunken nailheads and pulling	11"	\$1.80
4. JIMMY BAR	Close-quarter prying, bolt- and rivet-hole alignment	16"	\$1.75
5. STRAIGHT RIPPING BAR	Wrecking, prying, nail pulling in close quarters	36"	\$1.75
6. STRIPPING BAR	Removing forms from poured concrete, prying, lifting, wrecking	36"	\$4.50
7. ELECTRICIAN'S CUTTING CHISEL	Shearing tongues and nails in flooring, wedging	8"	\$3.85
8. OFFSET RIPPING CHISEL	Prying, driving under nailheads, 3-step pulling	18"	\$2.65
9. FLOOR AND CLAPBOARD CHISEL	Removing clapboards, shearing nails, opening crates, prying	18"	\$3.30

PRY BARS:

Lift 5 tons or pull a nail

By George Daniels

WHAT are the toughest tools in the store? They're the ones usually called wrecking bars. Their ranks include crowbars, ripping bars, stripping bars, ripping chisels, and a host of others in sizes and shapes to fit every job. They can pull nails a hammer can't reach or budge—and often with half the handle pressure a hammer needs.

Basically, they're leverage tools. They can pry up a five-ton machine for leveling, open a crate, free a stuck window, or wreck a house. In special railroad form, they enable one man to roll a fully loaded 40,000-pound freight car. Firemen save lives with them, demolition crews level buildings with them, and burglars give them a bad name.

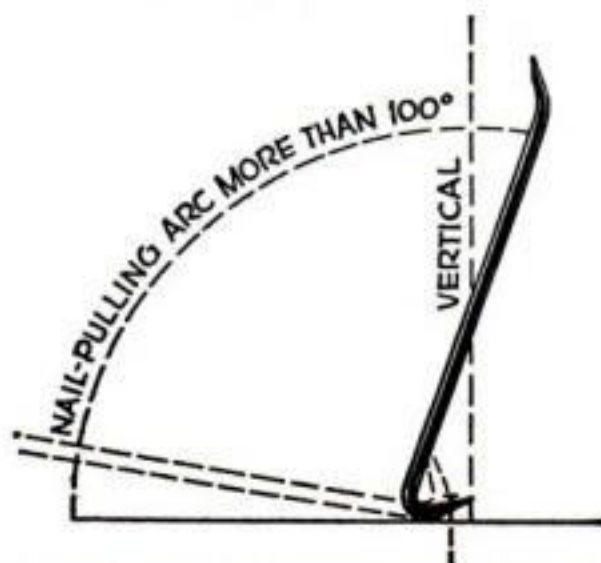
Most of them are in the low-price range, with an average cost of around \$3 for those shown here. You have to buy them according to the shape because their exact names often vary with the maker, the line of work, and the locality.

The gooseneck ripping bar. This is sometimes called a pinch bar. With an angled blade at one end and a hooked claw at the other, it's your handiest initial buy at around \$2 for a 36-incher. (You can buy one as short as 1' for under \$1.)

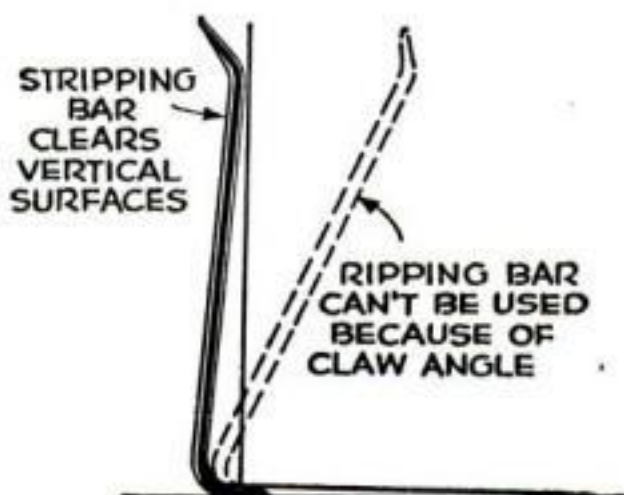
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Why you need different bars for different jobs

Gooseneck ripping bar has a sharp-angled claw that gives you a long swing for pulling large nails. It removes a 6" spike completely in one stroke.



Stripping bar has a shallower hook than gooseneck bar, enabling it to work close to vertical surfaces for lifting jobs. It gives a lift of almost 6".



Straight ripping bar is short and has only slight bends so it can work in close quarters. Its flat claw lets it pull nails that a hammer couldn't reach.





Chisel-edged nail claw is sharp enough to let you drive it under a sunken nailhead that you couldn't reach with a regular hammer claw. Once nail is hooked, claw is rocked back

against the curved neck, giving you a built-in fulcrum. Unlike a hammer, the tool is free to swing all the way down flat for maximum pull because there's no head to get in the way.

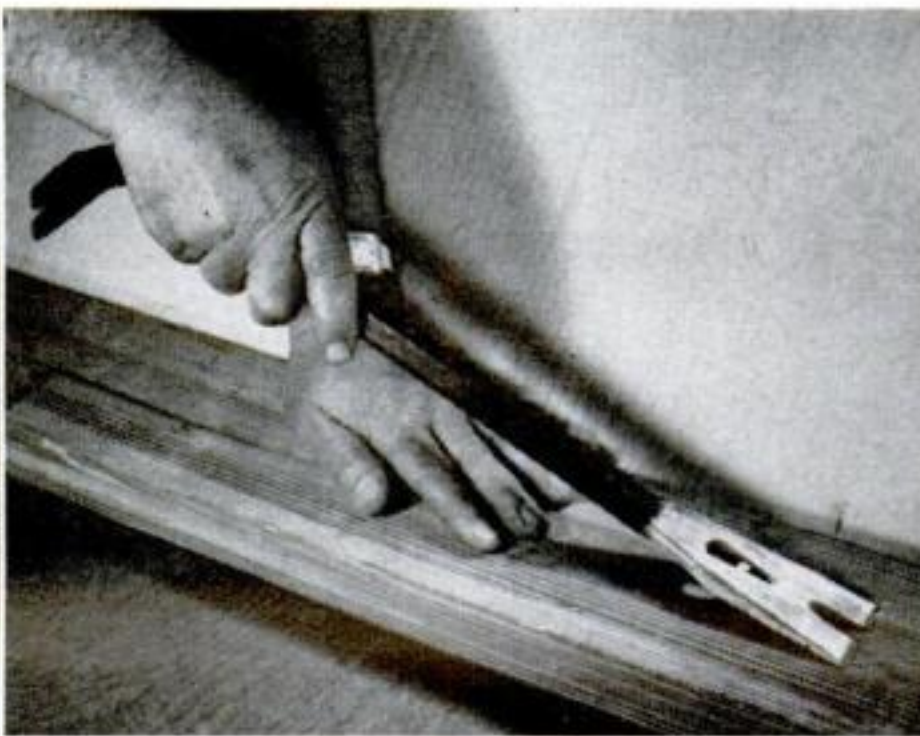
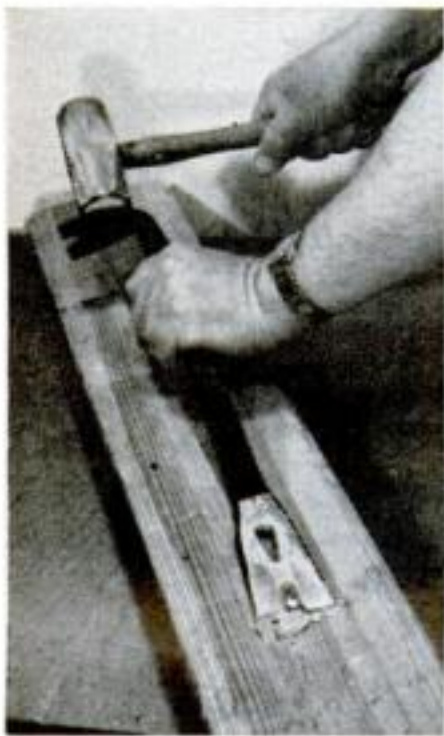
The yard length gives you about double the nail-pulling power of a claw hammer for each pound of pressure at the handle end. It takes about 440 pounds to yank a 10-penny nail from a fir beam. This means more than 100 pounds of muscle power with a claw hammer, but only 50 pounds with the bar.

studs and planking when you take down an unwanted shed or porch. Then insert the gooseneck claw and rock it back to complete the job. That's the method used by the wrecking pros.

Spear the bar's blade under the nailhead to dig a space to wedge in the claw. Use the same spear action to separate parts like

If the gooseneck must rock on a finished surface, as in prying a sill from a polished floor, slide a scrap of $\frac{1}{4}$ " plywood under it to take the dent. For heavy lifting, your greatest power comes from the opposite

[Continued on page 176]

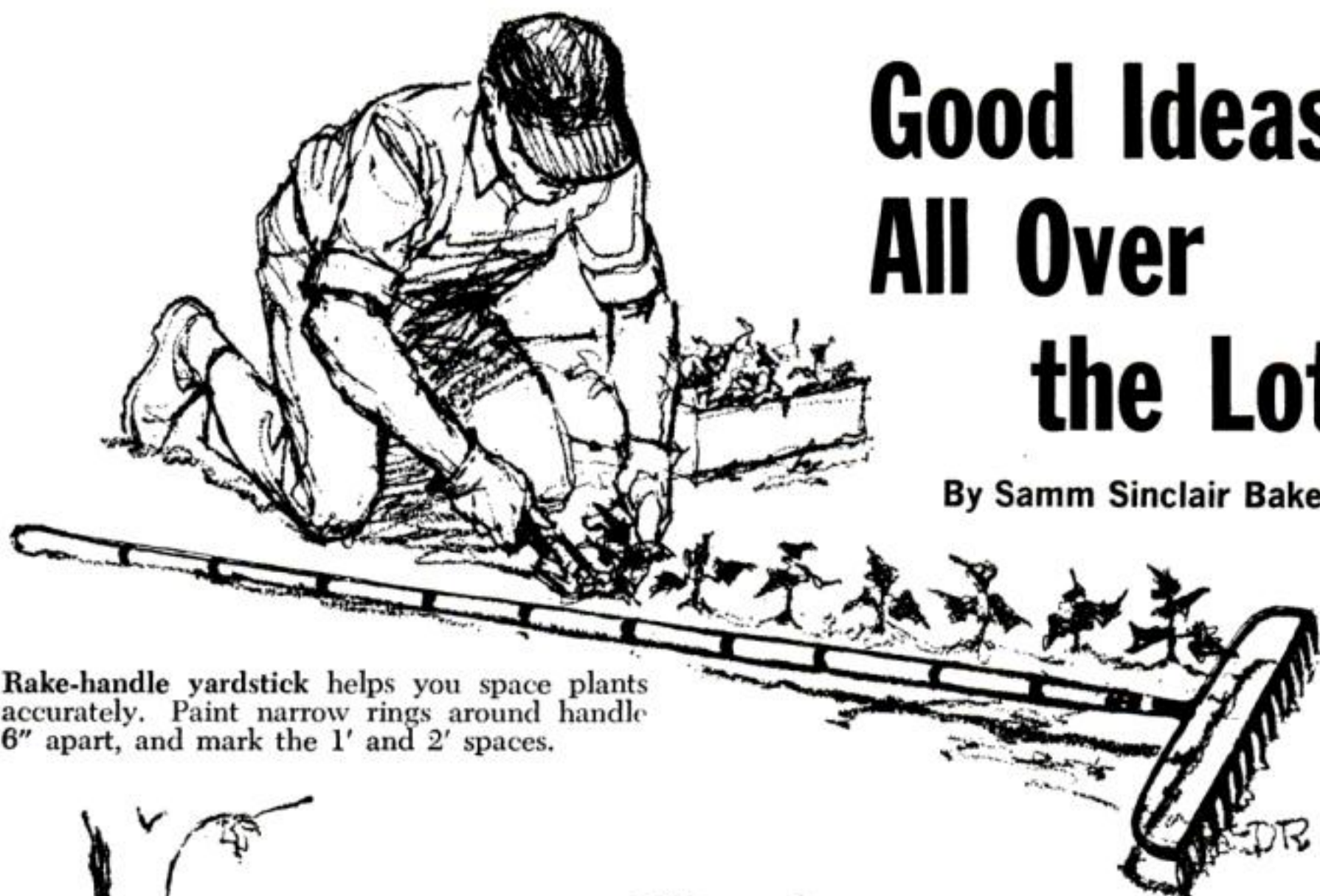


Offset ripping chisel lets you pull nails in three steps. Flat claw is driven under a sunken head (left), and the slight bend gives you enough leverage to start the nail up. When the head is

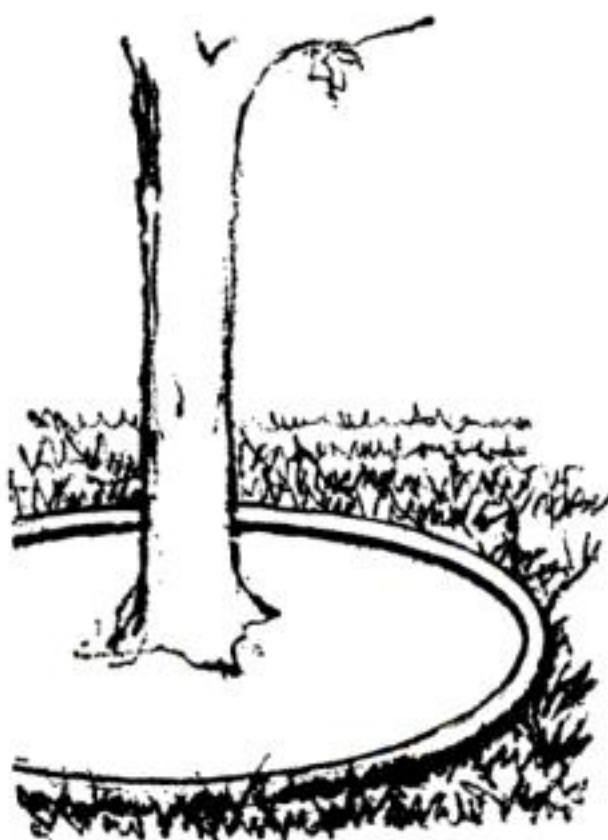
exposed, you hook it in the slot above the claw for maximum leverage (center). For final pull, you switch to the claw in the offset end (picture at right) to give you a long swing.

Good Ideas All Over the Lot

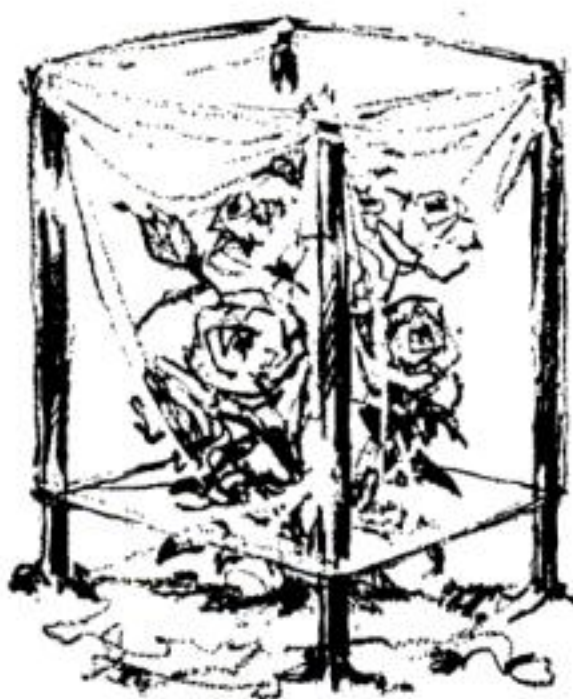
By Samm Sinclair Baker



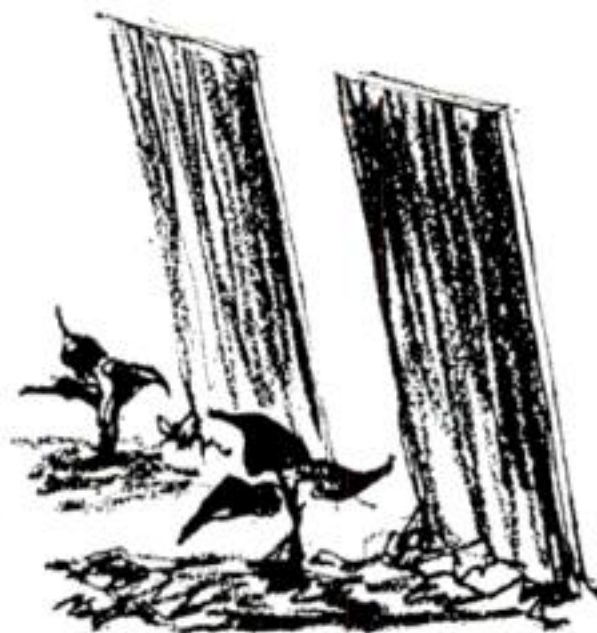
Rake-handle yardstick helps you space plants accurately. Paint narrow rings around handle 6" apart, and mark the 1' and 2' spaces.



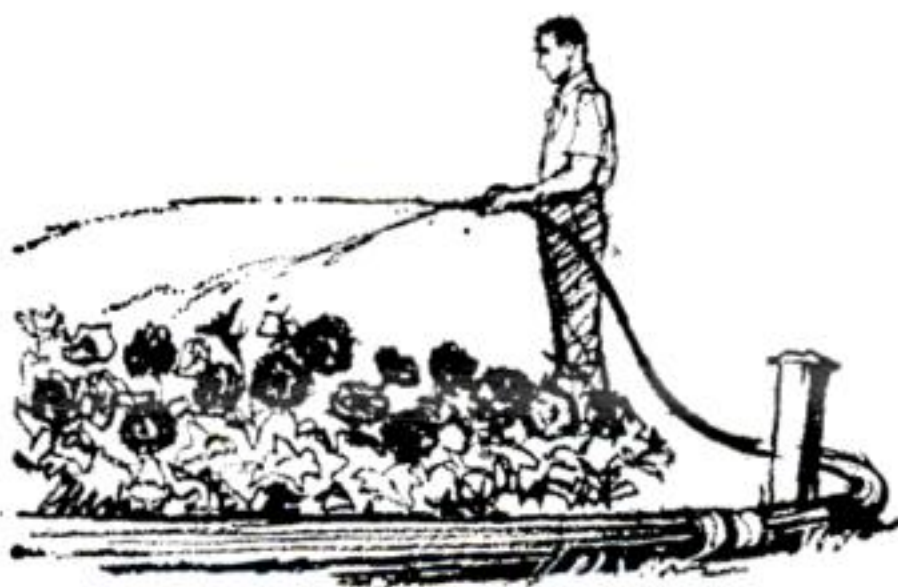
Keep grass from creeping up to a tree trunk or a shrub by embedding a hoop around it.



Plastic bag over four stakes makes a "hothouse" to protect young plants from cold.



To protect seedlings from hot sun, place shingles on south side, slanted toward the plants.



Set a strong stake at the corner of a garden bed to protect the plants from being roughed up or crushed by a pulled garden hose.



Old garden hose makes excellent padding for the top of spade to save shoes. Cut hose to size, slit, and fit. Use also as pail handle on wire bale.

How to Poison Bugs ...but NOT Yourself

A few simple rules will keep you safe when you apply insecticides to shrubs, trees, or lawn

By Jorma Hyypia

WHATEVER your opinion of *Silent Spring*, Rachel Carson's controversial book about insect killers, you'll get no argument at all about one obvious result—users of insecticides are having searching second thoughts this season about bug poisons. The big question they're asking: Can you use pesticides safely? The answer: Yes—but you must work with care.

Chances are, you've worried more about the effectiveness of the chemicals you use to control bugs and plant diseases than about what they might do to *you*. Actually, you can kill bugs and control diseases—*without* endangering yourself, your family, or your neighbors. Here's how:

- Read the label on the package.
- Keep chemicals off your skin. This applies to both liquids and powders. If you get any on you, wash it off at once. Wear protective clothing.
- Cover bird baths, dog dishes, and fish pools.
- Keep out of drifting spray. Avoid

The rule of first importance:



Put on protective clothing before you begin applying either spray or dust. Reason: Some pesticides are absorbed through the skin. The sketch above shows a safe outfit. In a confined area, a respirator is also advisable.

What's the story the labels tell?

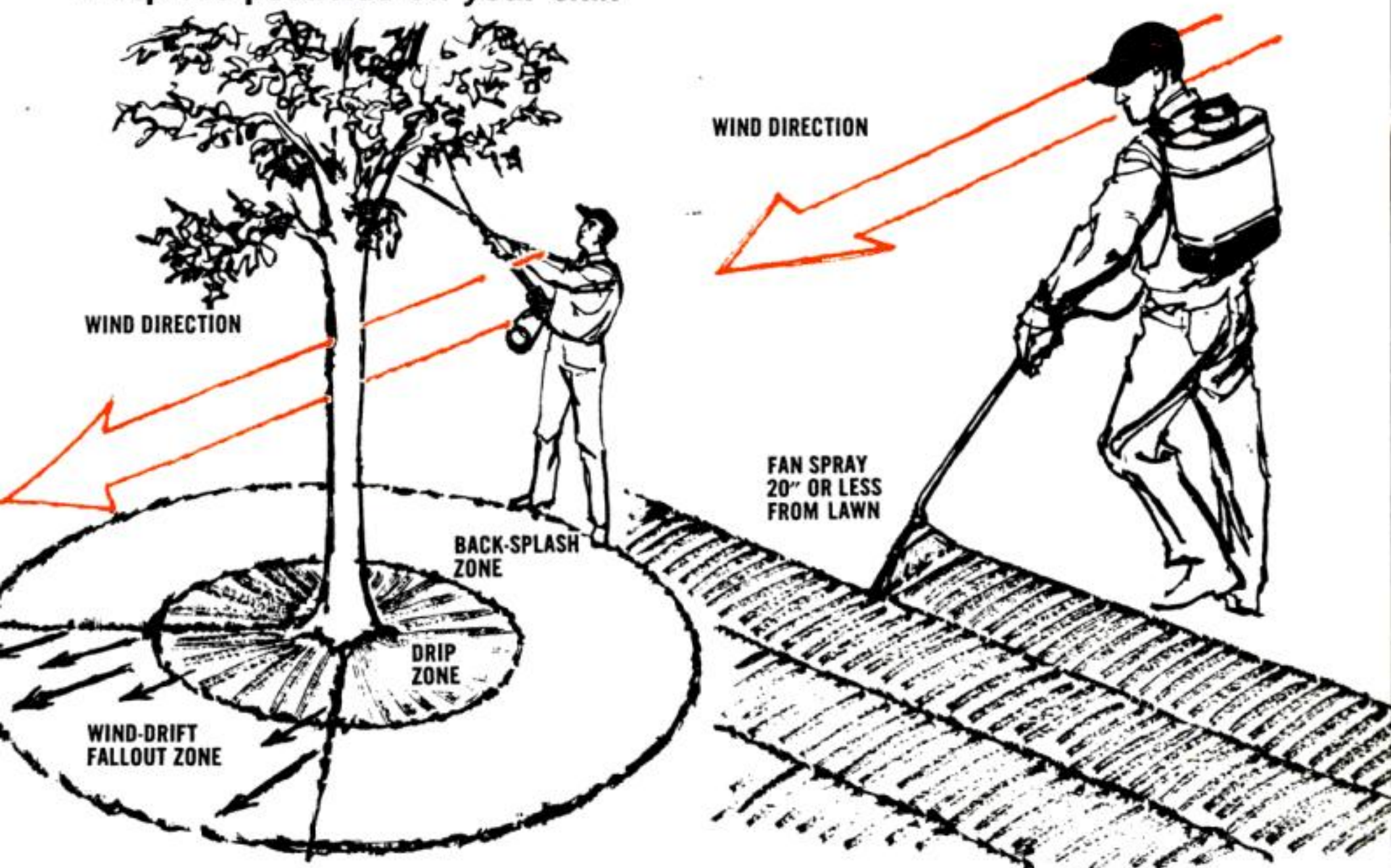
NONTOXIC TO HUMANS

When you find the above phrase on a package of insecticide, you'll know that you are working with a fairly safe pesticide. But it still pays to be careful.

CAUTION

Low order of toxicity is indicated by the word CAUTION in the wording of a label. But it's still best to take no chances. Manufacturers of insecticides are subject to federal regulations that establish the degree of toxicity for a product. Label wording is usually mildest permitted by law.

Keep the pesticide off your skin



Always work so the wind blows away from you. That way you'll avoid having an invisible mist of spray drift back into your face. Unless the day is calm, you should spray a tree from only one side. For spraying a lawn, adjust the nozzle

for a fan pattern and work so you move into the wind as you go back and forth. Keep children and pets out from under shrubs and trees for a few hours after you have sprayed to avoid any chance of the liquid dripping on them.

Shown in color here are the key words to look for



Beware! If you find the word **WARNING** on a label, you can be sure that it's a far more potent poison than one that carries either **NONTOXIC** or **CAUTION**. Follow directions exactly.

Warning



Leave it alone—if a label bears the old-time poison symbol shown at the left. That's probably the best advice for most home owners—although such insecticides can, of course, be used safely by pros who have the proper know-how and the right equipment.

For safety, keep your equipment in good shape



Adjust sprayer nozzle for a fine conical pattern and work close. This conserves insecticide and keeps it off other plants. Upturned nozzle puts spray effectively on the underside of leaves. When it's time for refilling, invert

sprayer (inset) to relieve remaining pressure if you use compressed-air type. Otherwise, opening the cap may shower the insecticide into your face. Sketch at right shows how a leaky duster may wrap you in a poisonous fog.

breathing insecticide dust as you apply it.

- Keep children and pets away while you're spraying or dusting. Never leave poison where kids can reach it.

- Use the correct strength of the insecticide indicated for controlling the specific pests you're after.

- Pour leftover spray into a gravel drive or over soil.

- Store chemicals in original container—with the label intact. *Never* place pesticides or fungicides in cabinets with food packages.

- Destroy empty containers at once. Wash out glass and metal containers before putting them in the trash can.

- Wash your face and hands before smoking or eating. Avoid smoking while spraying.

What you can learn from labels. First

of all, you'll find instructions for applying the chemical to get the desired results. You'll also find an indication of the hazards.

Safest of all are products labeled **NON-TOXIC TO HUMANS**. Clear as this appears, it's foolish to use even these relatively safe chemicals with complete abandon—as many do.

Why? Because the term "nontoxic" really means that laboratory tests indicate that the insecticide has a low level of toxicity to rats. But a man is not a rat, and you must take on faith the premise that chemicals only slightly toxic to rats are likewise only mildly toxic to humans. Remember, too, that these laboratory tests generally concern acute toxicity; testing of long-term chronic toxicity—the long-term built-up effect—is still very much in the scientific never-never land, and little is said about it.

The word CAUTION on a label also implies a low order of toxicity and relatively little hazard.

But when you find a WARNING on the label, you are handling a far more poisonous material. Follow *all* label directions *exactly*. Do not, for example, mix the insecticide in greater strengths than directed.

If the container says POISON and bears a skull and crossbones, *don't buy it*. You don't need anything that risky.

What ingredients? The ingredients list on the label can reveal—to a degree—the relative toxicities of various chemicals. The numbers in the accompanying table refer to the amount of each poison required to kill half the rats in a laboratory test. Note that the larger the number, the less toxic the chemical.

Such chemicals as TEPP, sodium selenate, and parathion are so toxic you should avoid them completely.

You should consider the relative amounts of active ingredients used in various formulations, too. But comparisons aren't always simple. Two competing products with the same amounts of identical active ingredients may differ markedly in insecticidal activity. Why? Because the inert portion of one formulation may contain additional chemicals that increase its killing power.

Commonly used additives include surface-active agents to aid wetting and penetration of leaf surfaces and insects, emulsifiers to facilitate dispersion of the concentrate in water, and synergists—chemicals that are not poisonous to insects, but that enhance the killing power of the active ingredients.

What will it kill? Check each label. Is the product suitable to your problem? It is foolish to spread poisons around that serve no purpose. Look for a product with the *least-toxic* chemicals that will do the job.

Never use insecticides in greater concentrations, or more often, than recommended. And don't, under any circumstances, use garden poisons inside the house.

The importance of clothes: Good examples of indifference to pesticide hazards can be found in photographs issued by pesticide associations, government agencies, and others who should know better. Bathing suits and shorts may be comfortable, but they are not proper attire when spraying or dusting poisons. Shoes, socks, slacks,



The table below shows comparative toxicities of various insecticides, established in laboratory tests on rats. Figures represent the milligrams of chemical per kilogram of animal weight needed to kill 50 percent of the rats. The most potent killers are at top.

How toxic is the insecticide you're using?

TEPP (most toxic)	2
Sodium selenate	4
Parathion	13
Methyl parathion	17
Endrin	20
Toxaphene	50
Aldrin	63
Dieldrin	80
Heptachlor	100
Lindane	125
Rotenone	135
Pyrethrins	200
DDT	250*
Chlordane	450
Sevin	600
Kelthane	650
Allethrin	680
Ryania	1,200
Malathion	1,400
Pyrethrum	1,500**
TDE (DDD)	2,500
Methoxychlor	6,000
Perthane	8,000

*Acute oral toxicity to man

**Tested on guinea pigs.

a hat, and a long-sleeved shirt should be worn. And don't forget rubber gloves—a sprayer may drip insecticide.

Remember that it is virtually impossible to spray for an hour or two without getting some spray or dust on your clothes. So wash your garden outfit frequently.

If you must work in confined areas (in a greenhouse or among high, thickly planted bushes) consider using a respirator. Inhaling insecticides can be as dangerous as swallowing them.

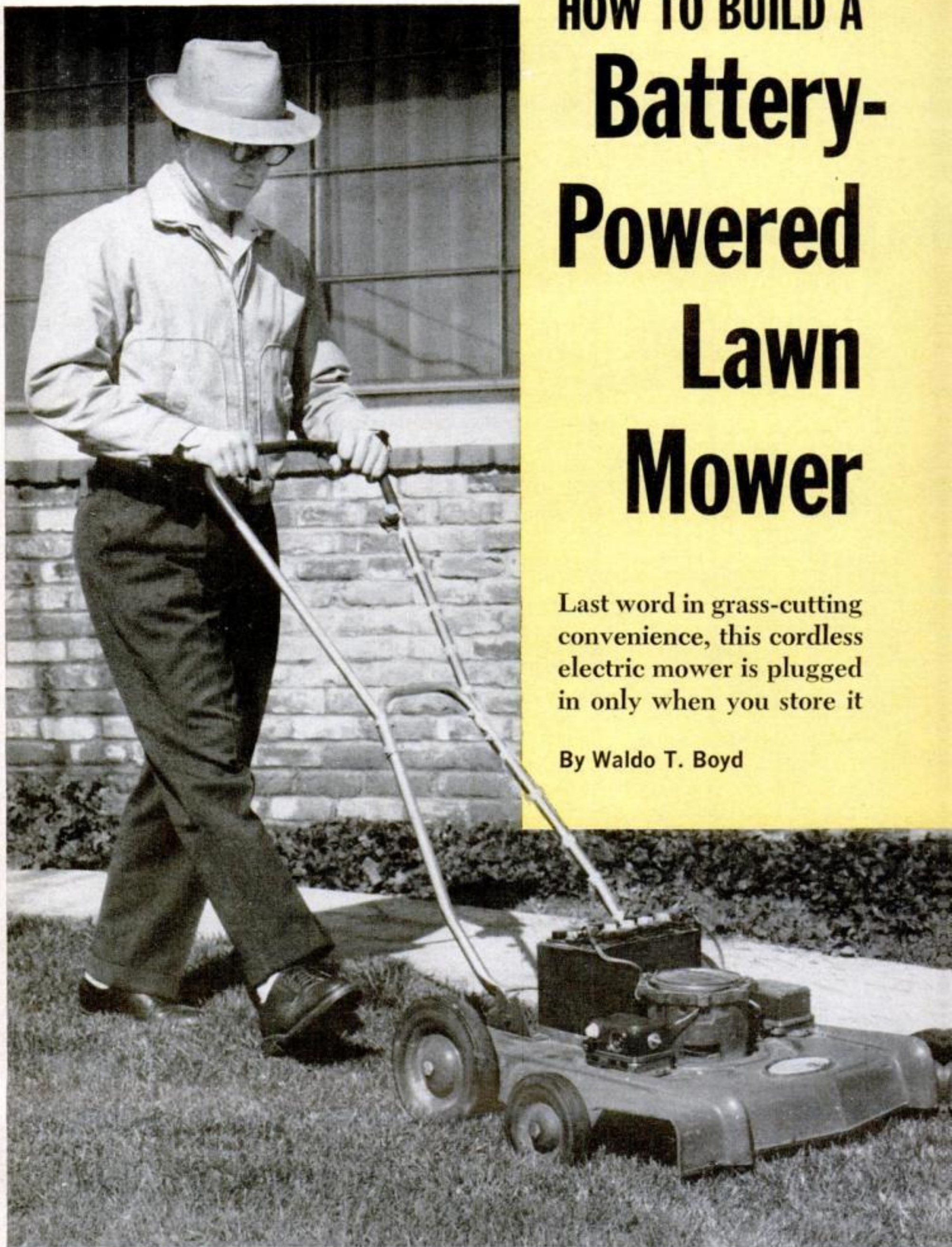
Sprays or dust? There are good and bad features about both sprays and dusts. Dusts have two shortcomings: They cost more than sprays (but equipment costs are usually less); and they are wasteful and unsafe on windy days. On the other hand, dusts are ready to use, eliminate the hazards of

[Continued on page 162]

HOW TO BUILD A Battery- Powered Lawn Mower

Last word in grass-cutting convenience, this cordless electric mower is plugged in only when you store it

By Waldo T. Boyd



With the battery fully charged, you can easily mow the average lawn without stopping.

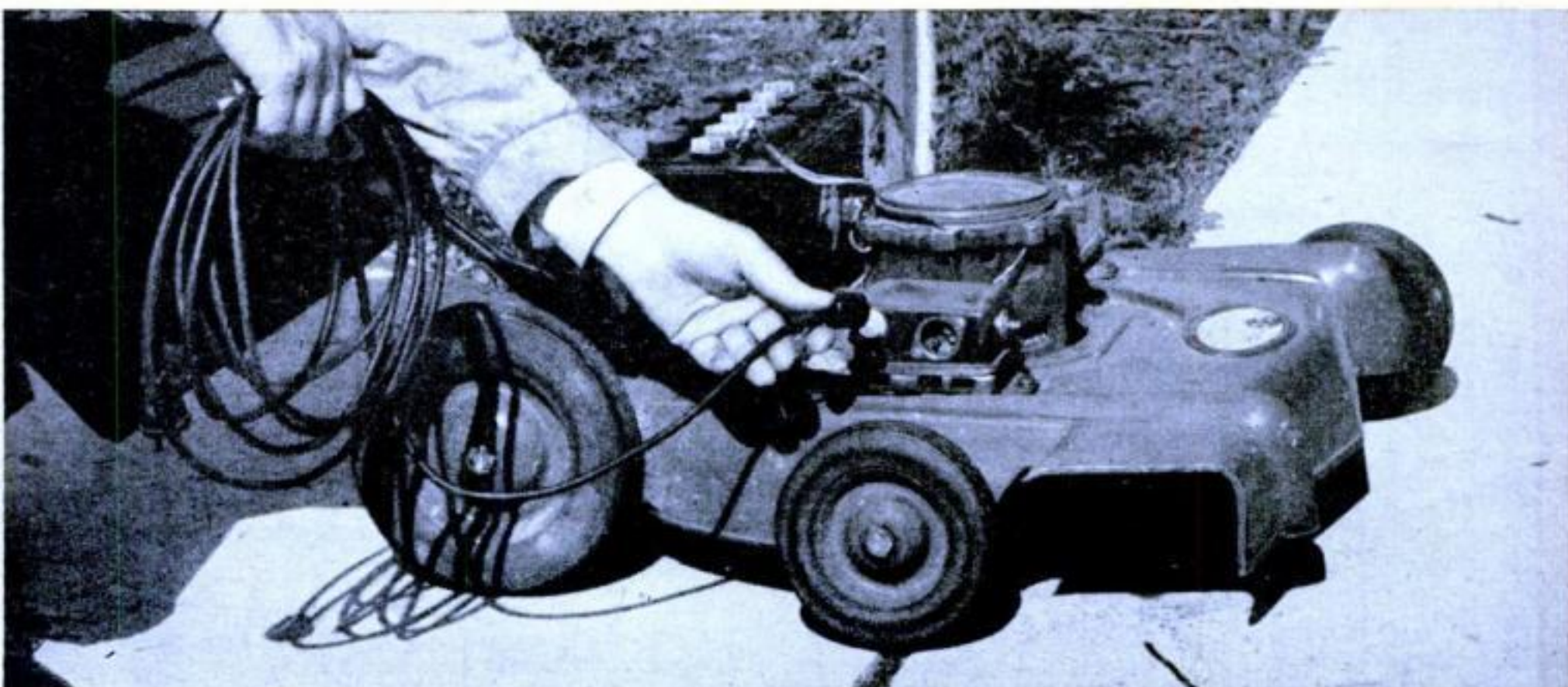
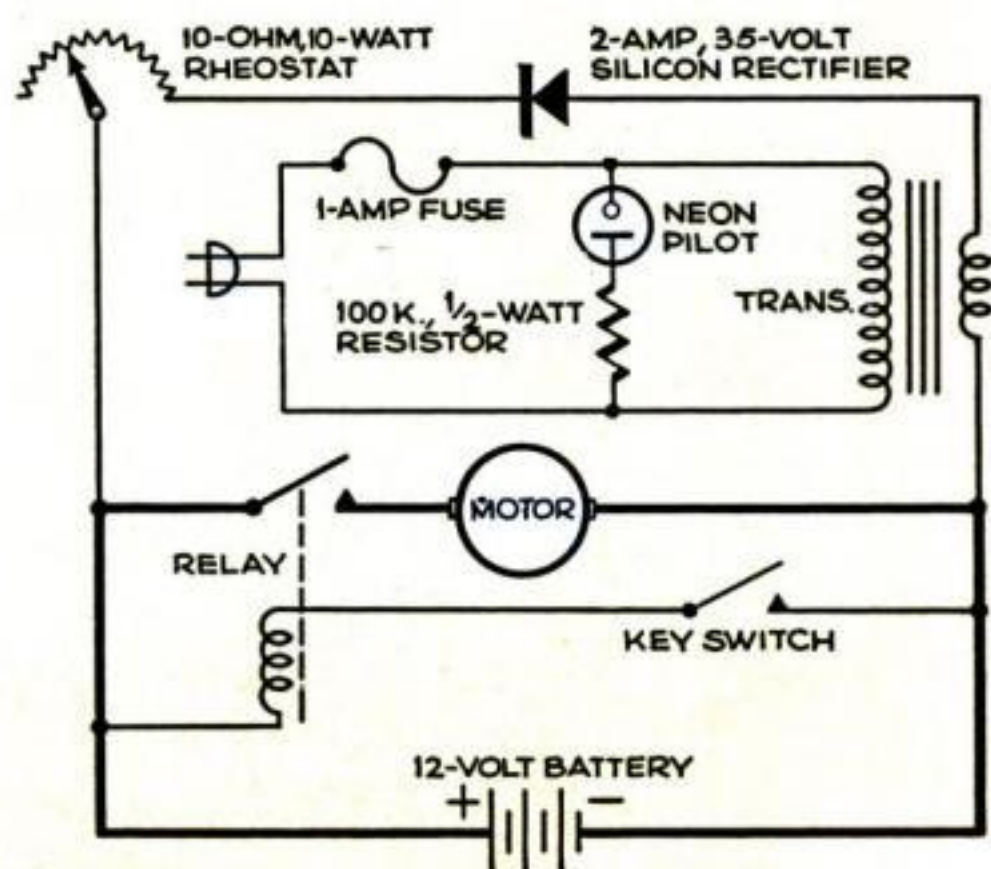
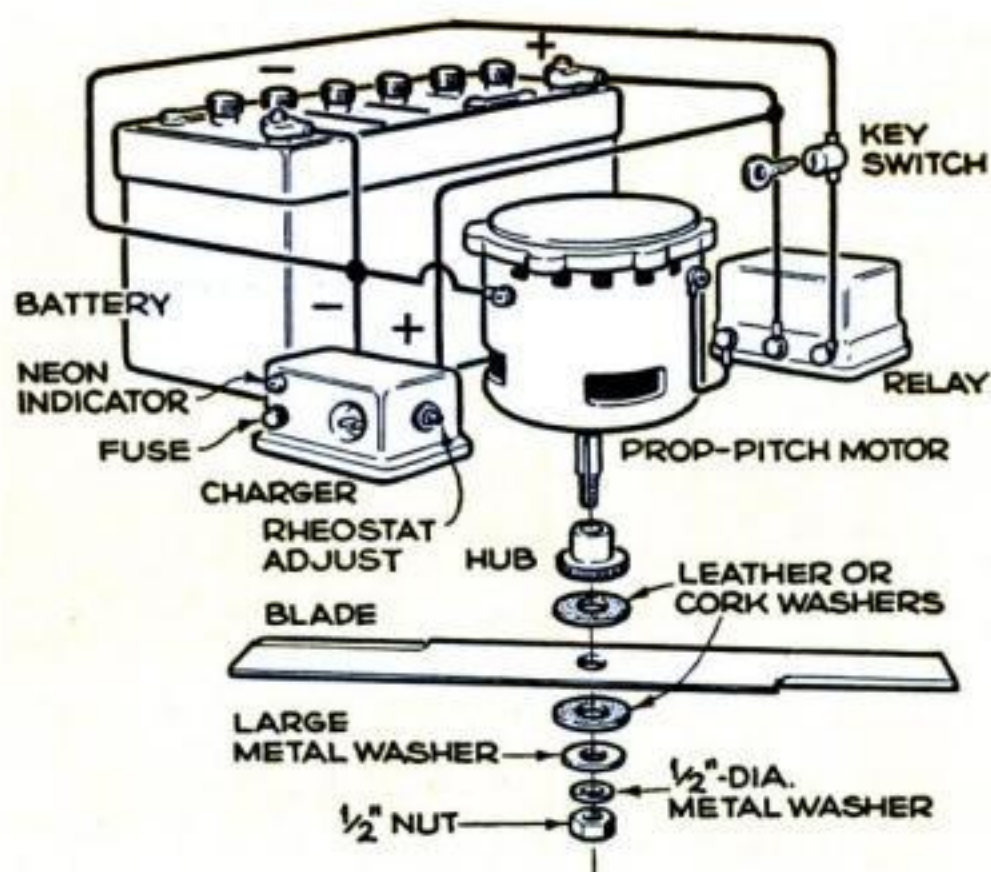
IF YOU choke at the fumes and are deafened by the noise of gasoline lawn mowers but are unwilling to trip over trailing electric cords, here's a project that'll solve your headaches. I freed myself of these nuisances for about \$30 by building a battery-powered electric lawn mower on an old rotary-mower chassis.

Such a home-grown bargain is made possible by the current availability of excellent DC motors on the surplus market.

Many alternatives will work equally well, so plan your project carefully before ordering all the parts. Don't box yourself in by ordering all the parts at once before you know whether they will work together. Best bet is to get your motor first. Since it is impossible to give specific details about all variations, it would be wise to line up a local expert.

Motor modification. Surplus "prop-pitch" motors are ideal. They are series-wound and require no field-coil modification. Further, they have a standard $\frac{3}{8}$ " keyway shaft with a $\frac{1}{2}$ "-by-20 right-hand thread. Most other surplus motors are shunt- and compound-wound, and may require modification of the field as shown in the diagram at right. A motor rated at 24 volts—as most surplus motors are—will work quite well with a 12-volt

CONTINUED



The battery is recharged overnight by plugging the built-in charger into a standard AC outlet.

PARTS LIST

ITEM	DESCRIPTION	APPROX. COST
Motor	Surplus: prop-pitch, 12- or 24-volt DC; or Delco marine generator, 12-volt DC. New: Replacement-part motor for manufactured battery mowers	\$5 to \$30 write maker
Mower chassis	Use your old gasoline-powered one or buy used with worn-out engine	\$5 up or free
Battery	Surplus: dry-charged, unused, 20 ampere-hour minimum, 12 volts. New: At least 20 ampere-hour	\$1 up per cell \$15 up
Relay & charger chassis	Junk: two identical Delco-Remy generator regulators from salvage yard	Free or nominal
Plug & socket	Arrow H&H midget connectors, Allied Radio No. 80325 and 80328	\$1.60
Lock switch	Junk: auto-ignition lock with key. New: Allied Radio No. 34B156	25¢ up \$1.15
Silicon rectifier	New: 1N253 (Motorola) or any silicon rectifier rated at 35 PIV, 2 amps or better	\$1.60 up
Charger transformer	Filament transformer, miniature, 12.6 volt. Allied Radio No. 39A586S or similar	\$1 up
Rheostat	Surplus: 10-ohm, 10-watt, approx. New: Allied Radio 29M457	25¢ up 95¢
Neon holder	Allied Radio No. 52E581 socket with built-in resistor	70¢
Neon bulb	NE-51, Allied Radio No. 52E373	25¢
Fuse & fuse post	Standard 3AG, 1/2 to 1 amp	55¢

battery provided it is rated about twice the horsepower of the equivalent 12-volt motor.

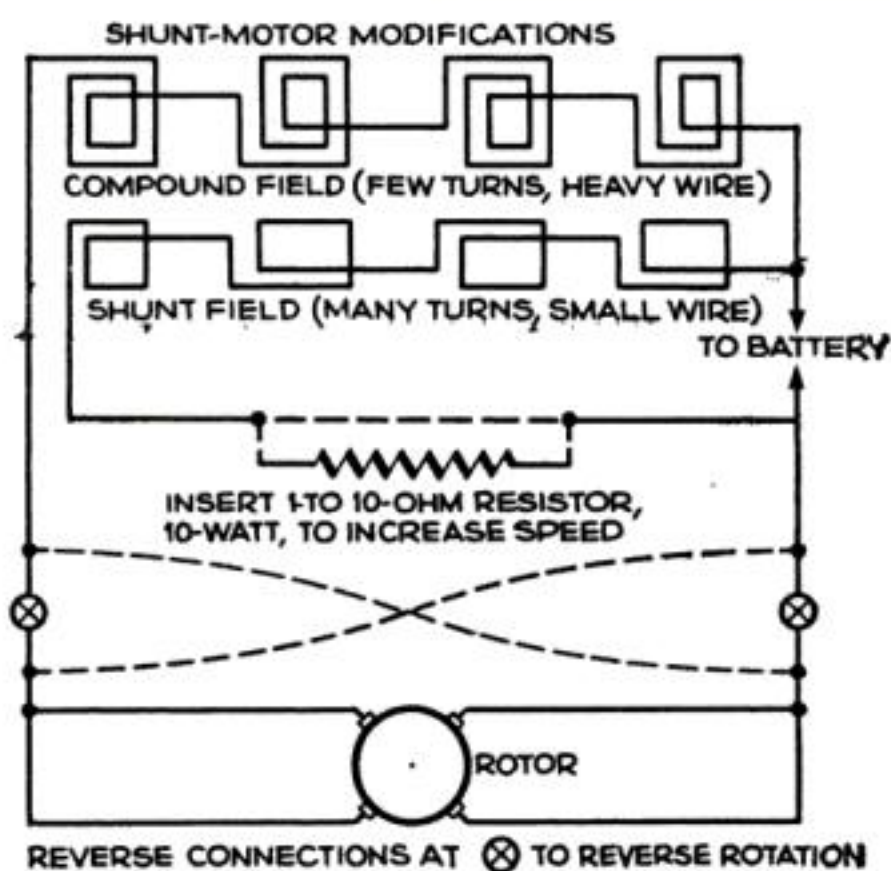
Remove the braking mechanism from the motor if this has not already been done by the surplus house, and retain the toothed hub, key, and shaft nut. Permanently short each of the two pairs of brake-solenoid terminals with heavy copper wire. Test

the terminals at the motor base by touching connecting wires quickly to the terminals of your battery. Mark the terminals that cause the motor to turn in a clockwise direction, the shaft pointing away from you.

To increase the speed—if rated at 24 volts, a motor will run at half speed with 12 volts—simply add resistance in series with the shunt field, as shown. One to 10 ohms, at 10 watts, is usually sufficient. If the motor runs “backwards,” (counterclockwise) reverse the connections of either the brushes or the field—not both.

The hub previously removed is used to mount the mower blade. Fill the hollow portion of the toothed hub with epoxy resin. Lathe-turn about 1/4" of metal from the

[Continued on page 164]



What you need to know about choosing parts

COMPONENT	ALTERNATIVES	COMMENTS
BATTERY	1. Purchase new or surplus	With care in purchase, surplus batteries will give good-as-new service and may be up to 50% cheaper. Usually available as cells—six required for 12 volts, at a minimum of 20 ampere-hour rating.
MOTOR	1. Buy a surplus prop-pitch motor; no winding modification required 2. Buy a surplus 24-volt, one-to-three-hp. motor, or DC generator 3. Buy “replacement” motor from a battery-mower manufacturer	Available in both 12- and 24-volt ratings. Either will work on 12 volts, but the former will perform better. Modify field by inserting resistor in series if motor runs slow. Buy mower blade with hole to match motor shaft. Convert generator to motor as described in text. Expensive, but will make the job easy, and performance will be tops.
TRICKLE CHARGER	1. Transformer secondary must be 12.6 volts or more	Small trickle chargers can be purchased new and mounted on the mower. Cut power cord to pigtail and attach male socket such as Allied Radio 52H721; matching female plug to be attached to length of cord with standard male plug on other end for wall socket.
RELAY	1. Buy 12-volt auto-horn relay at auto junk yard 2. Buy 12-volt auto-starter relay 3. Buy surplus 24-volt relay 4. Obtain 12-volt auto regulator from garage	Will work, but solenoid may burn out; if this happens, rewind with wire three to six sizes smaller than original. Rewind solenoid with smaller wire, as above. Rewind solenoid with wire three sizes larger than original. Be sure contacts will carry 10 to 20 amps continuously. Modify as described in text.



For more
outdoor living space
this summer

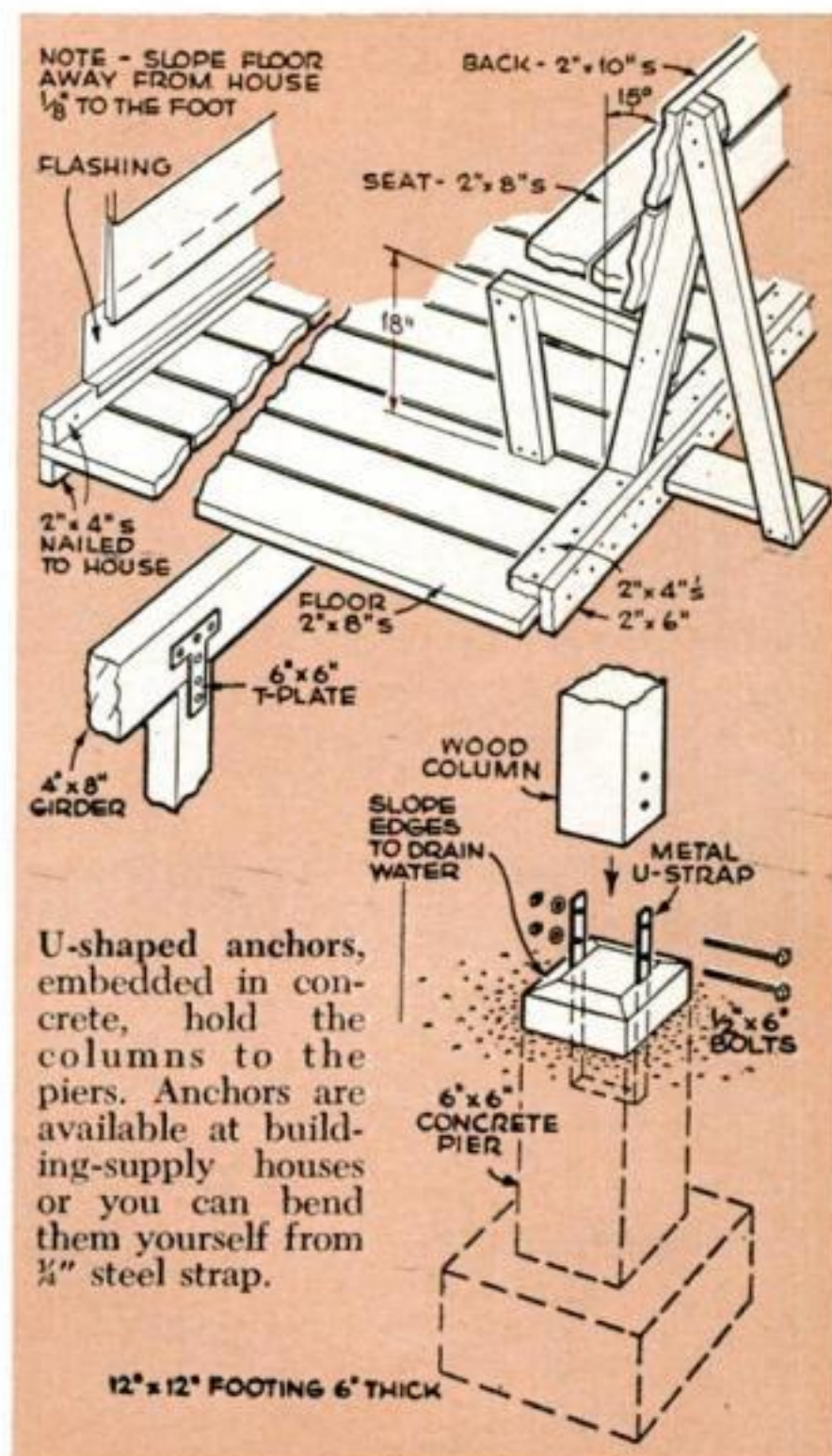
Add a Sun Deck

ONE of the easiest and cheapest ways to add outdoor living space is to build a wood deck onto your house. You get a readily accessible area at floor level—with your house wall contributing most of the support.

The deck shown here requires only two columns if the span between them is kept within 12'. For longer spans, additional columns can be used. The height of the columns can be adjusted to allow for sloping ground or to support the deck at the second-story level, as here. For a ground-level deck, it's best to rest the girder directly on the concrete piers.

The two-by-eight floor planks should be no longer than 8', except for the two that extend out to support one bench. The inner ends rest on two-by-four cleats nailed to the house. These can be fastened on right over the siding; but use 20-penny spikes and be sure they go into solid wood (studs, joists, or the sill plate). The uprights that support the bench seat slope back 15 degrees for a comfortable sitting angle.

The piers should be set out from the house a distance equal to two-thirds of the deck's width, or 5'4" for an 8'-wide deck. Use a 1:3:4 mix of cement, sand, and aggregate for the concrete. Place a waterproof membrane over the tops of the piers before bolting on the columns. The girder is tem-



porarily toenailed to the columns and then bolted with T-plates.

The deck shown here is one of 12 home projects described in a booklet that you can obtain free from the Wood Information Center, National Lumber Manufacturers Association, 1619 Massachusetts Ave., N.W., Washington 6, D.C.



Poles laid on bank build up sand at foot of protected beach.



Jute protects critical beach areas while new grass takes root.



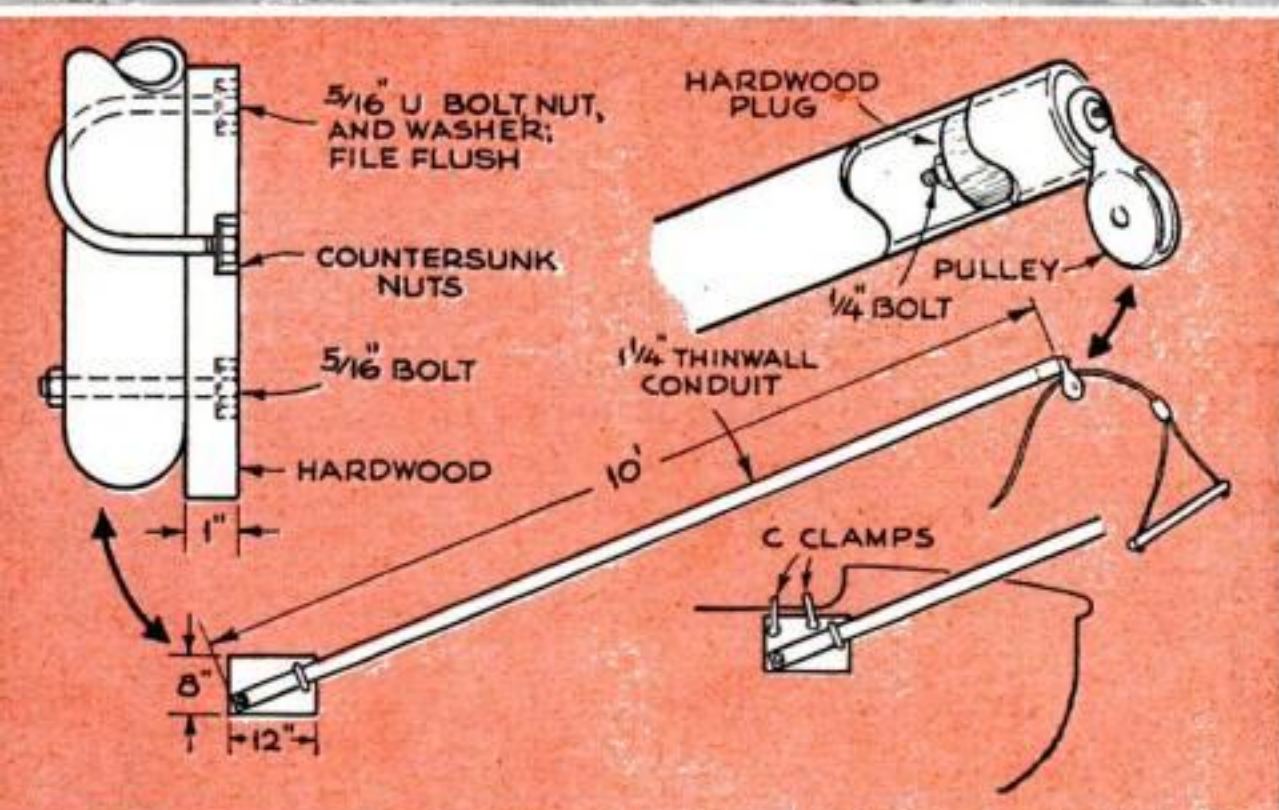
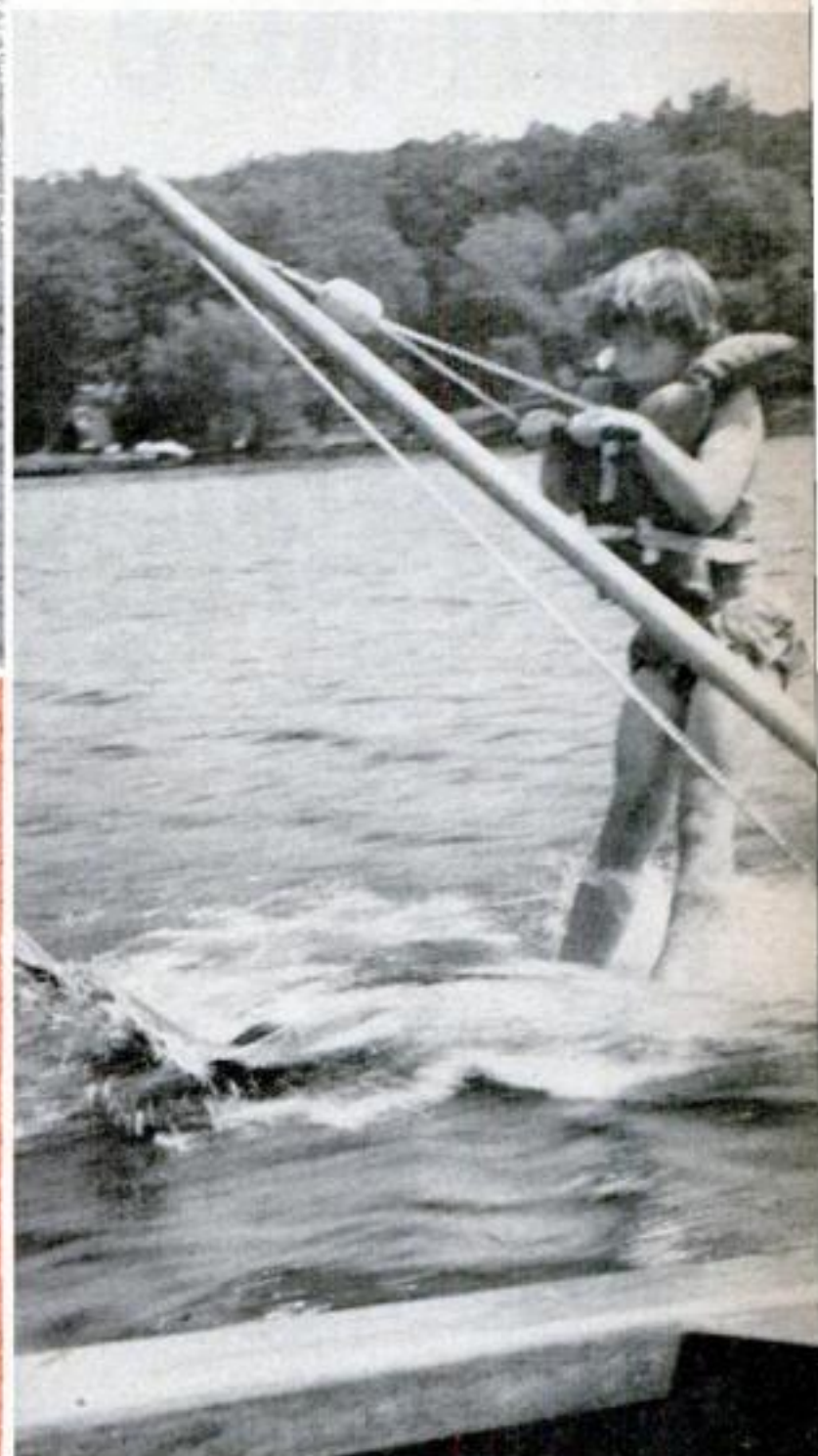
High-water line, indicated by Showell, shows grass holds its own.

Stemming the Tide with Turf

WHEN Sam Showell built his waterfront cabins on Indian River Bay, Del., the beach was ragged and eroding. Today, following a plan worked out by plant expert Marshall Augustine of the U. S. Soil Conservation Service station in Beltsville, Md., it's a grassy turf.

Clearing the debris, Showell shaped a gentle 3:1 slope and spread topsoil. Two lines of salt-meadow cordgrass were planted at the high-tide line to form a tight cover for the sandy soil. To slow down waves, four lines of American beach-grass came next—it grows two feet tall.

Showell sprigged the next 10 feet (critical area) with Midland Bermuda for a tight sod. He seeded Kentucky 31 tall fescue—a grass that resists heavy traffic—on the top 35 feet. Jute, a fiber mesh, protected beach from erosion until grass provided cover. Maintenance: Add lime, fertilizer, and cut the grass.



HOW TO MAKE A

Ski Boom for Teaching Small Fry

THIS training boom can save a lot of frustration at both ends of a ski-tow rope. A secure grip gives the learner a chance to concentrate on keeping his feet lined up. The coach in the boat is in a better position to observe and correct errors.

The boom is a 10' length of $1\frac{1}{4}$ " thin-wall conduit. For the mounting pad, a piece of tough hardwood is best. Countersink the nuts on the U bolt to prevent denting the transom. C clamps are good for holding the mounting pad to the boat. They permit adjusting the angle of the boom to the height of the student.

To give a beginner the "feel" of the skis,

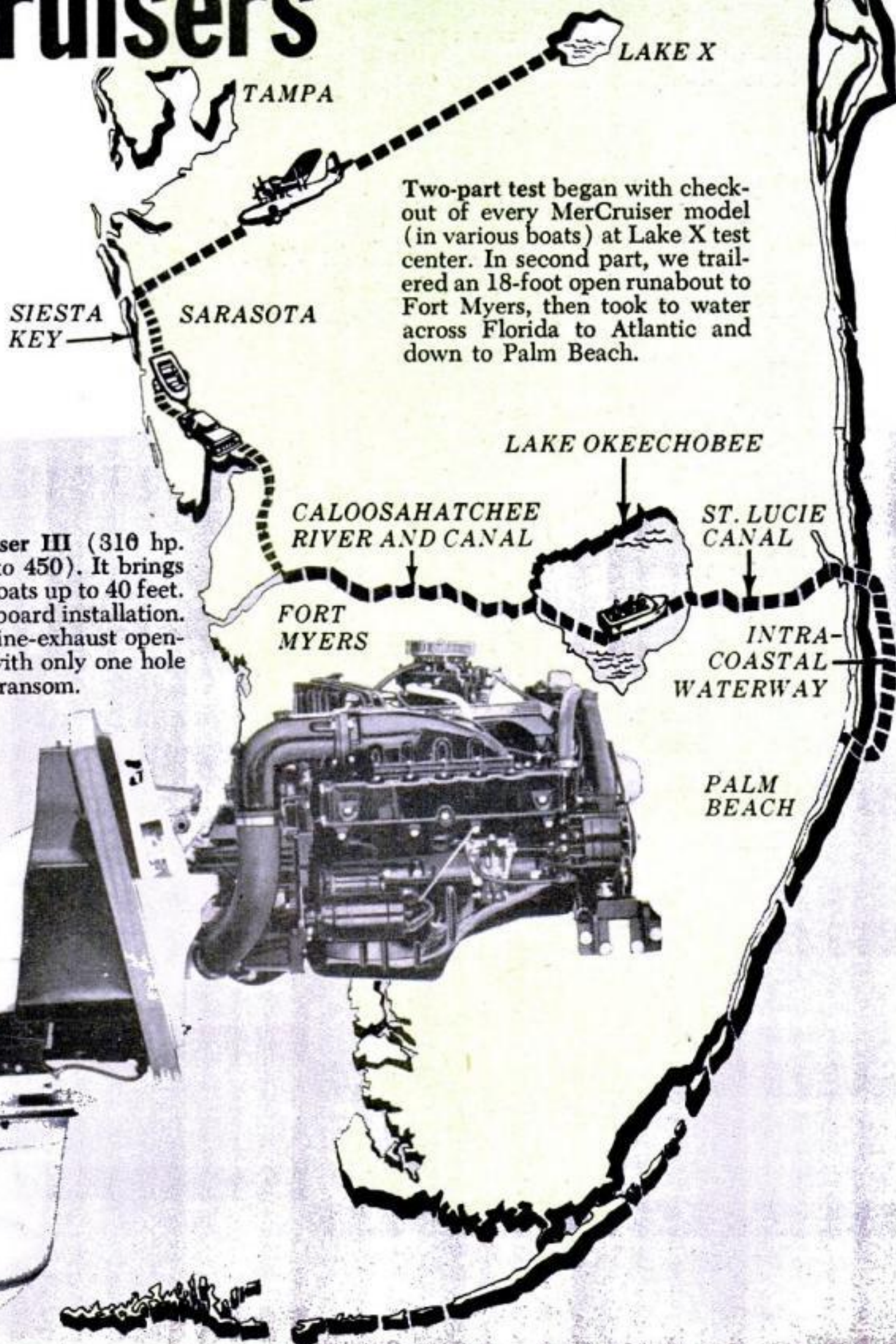
the boom itself makes a good tow pole. Using rope and pulley, however, gives the student a chance to stabilize the skis, transfer to the tow-rope grip, and gradually drop back from the side of the boat to the normal skiing position as you ease out rope.

A word of warning: While using the boom, even a small child exerts considerable leverage when the boat is dead in the water. Be sure your boat is heavy and wide enough to take it without capsizing. Give yourself plenty of open water to try the boom, so there's no danger of the skier hitting a pier, a docked boat, or other obstruction.—*E. F. Lindsley.*

Jim Roe Tests All the MerCruisers

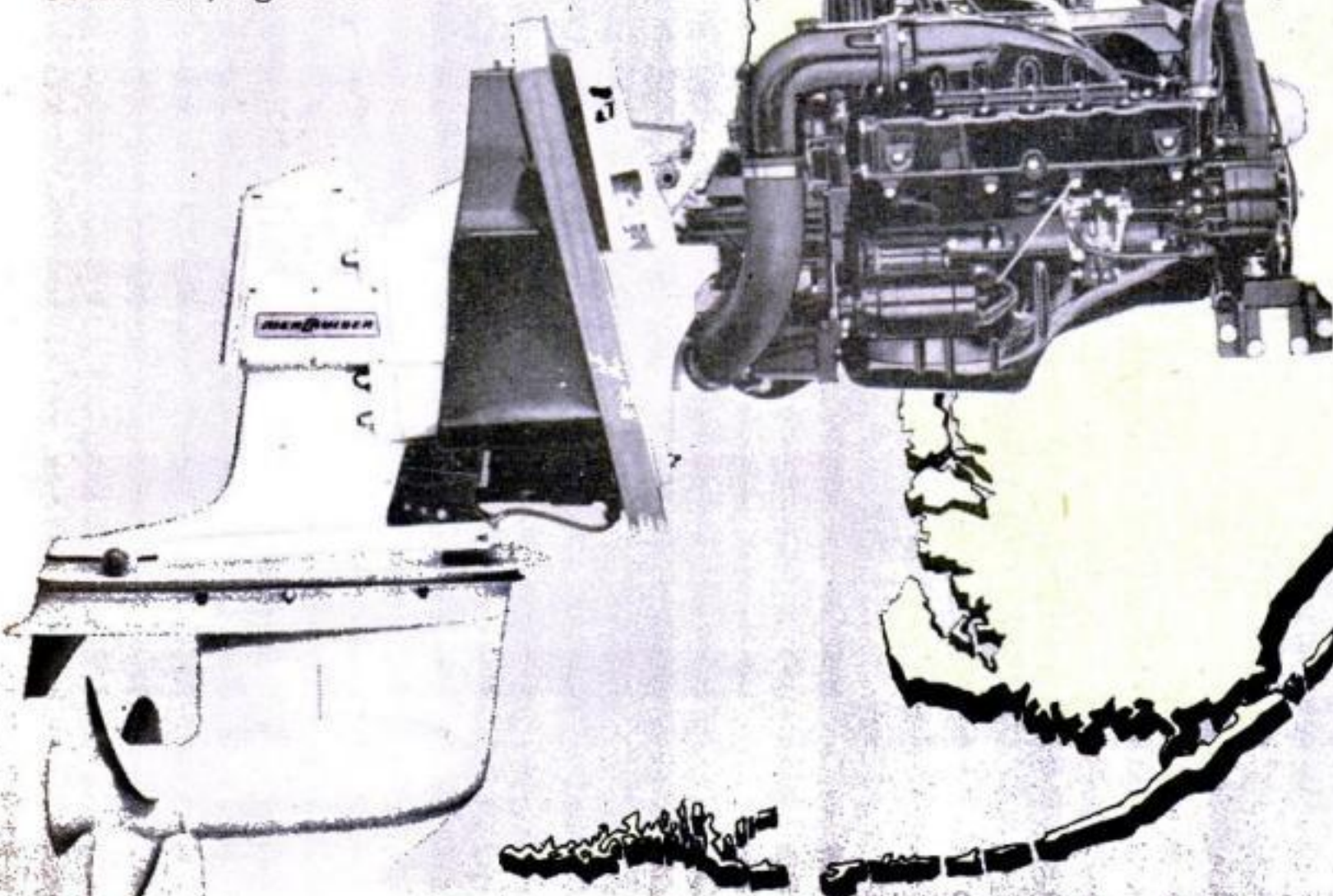
By Jim Roe

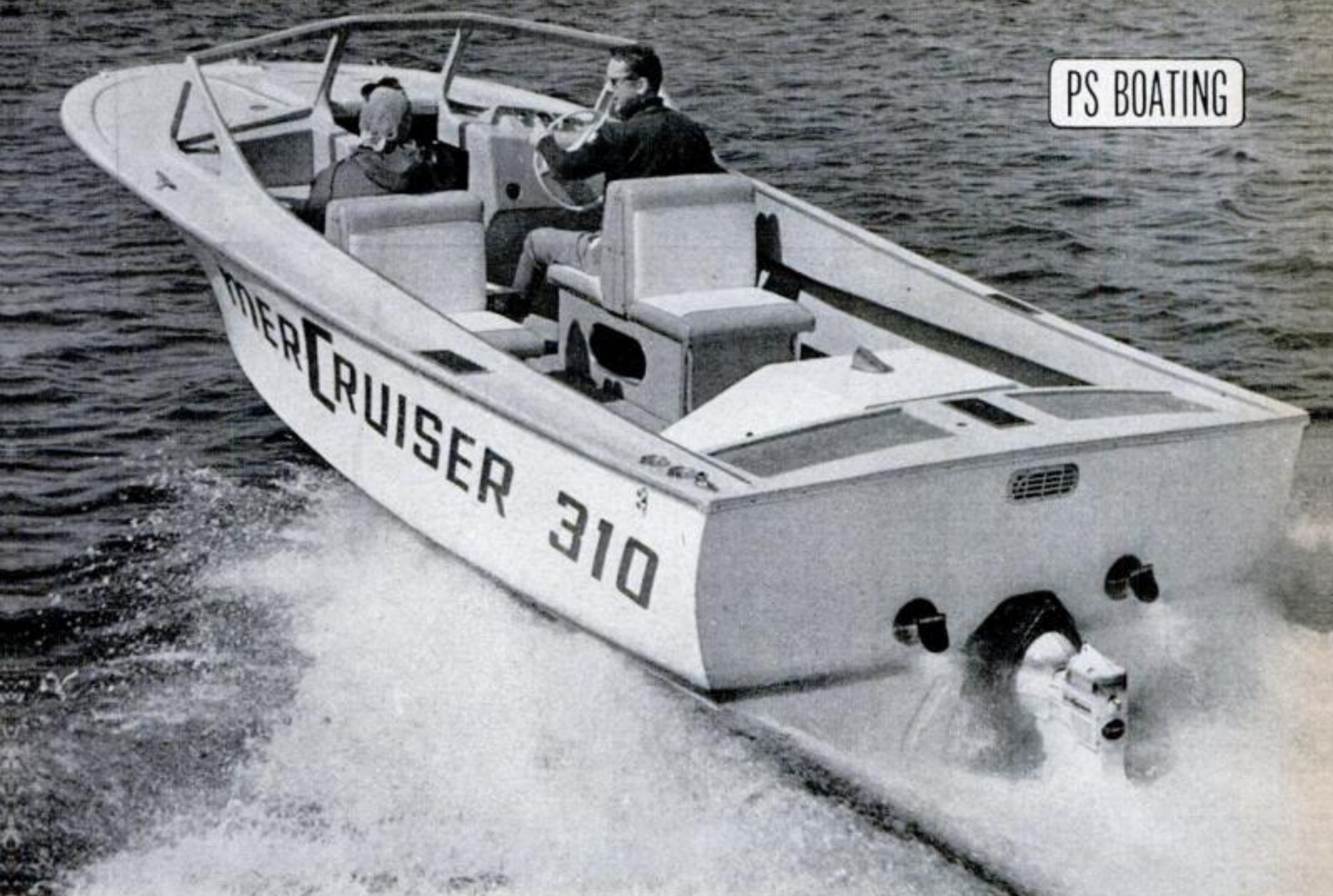
PHOTOS BY ED FINLEY



Two-part test began with check-out of every MerCruiser model (in various boats) at Lake X test center. In second part, we trailered an 18-foot open runabout to Fort Myers, then took to water across Florida to Atlantic and down to Palm Beach.

Newest unit is MerCruiser III (310 hp. and designed to use up to 450). It brings stern-drive principle to boats up to 40 feet. Photo shows inboard-outboard installation. All water-intake and engine-exhaust openings are in drive itself, with only one hole in the boat, high on the transom.



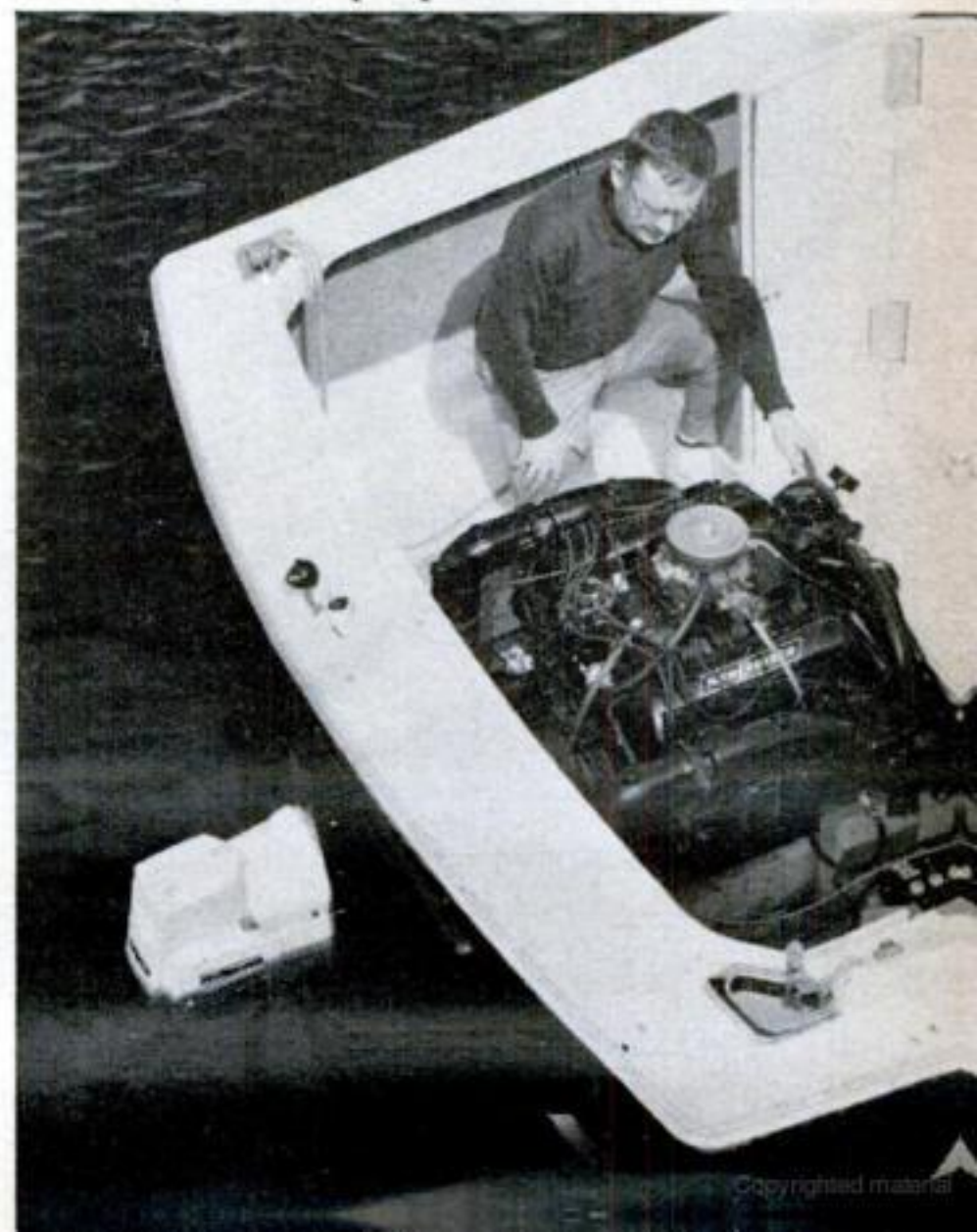


I'VE just completed a long session of speed, spray, and surprises. Starting at Carl Kiekhaefer's fabulous, tightly guarded Lake X test center in central Florida, I tested MerCruiser's stern-drive power packages in combinations ranging from 110 horsepower to a stupendous 950—and at speeds sometimes over 60 m.p.h.

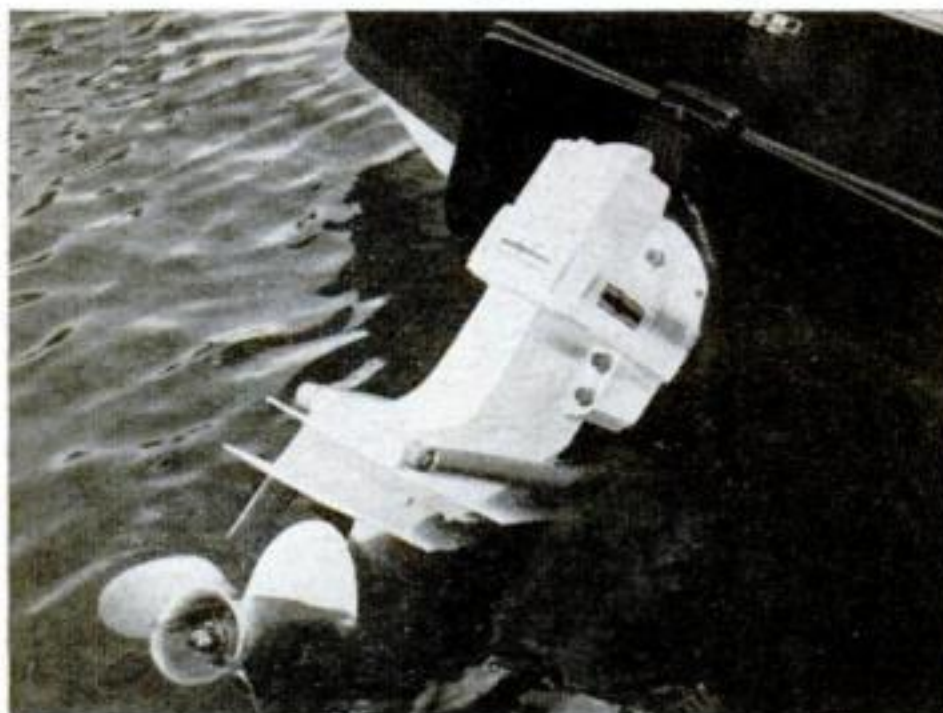
From Lake X, I took a MerCruiser-powered 18-foot open boat and roared coast to coast—Gulf to Atlantic—across Florida and down the Intercoastal to Palm Beach.

By the time I slid past President Kennedy's Honey Fitz at her moorings just inside the Palm Beach inlet, I'd decided that the MerCruisers had abundantly demonstrated their ability to put new pep in almost any boat. These happy marriages of inboard engines and outboard drives have often added 20 percent more speed to a hull than that delivered by conventional inboard engines and sloping, through-the-bottom propeller installations. In fact, stern drives have been so consistent in their ability to get a boat from here to there in a hurry that they've even begun to dominate some big-time boat races. Each year, more

MerCruiser II (above), unlike the I and III, exhausts through transom and has scoop-type water pickup. This 310-hp. unit drives a 20-foot Vega very effectively, I found in my rugged PS test runs. A MerCruiser III installed in a 25-foot Bertram (below) gives that heavy boat all the pickup and maneuverability of a small runabout, with ample power in reserve.



Bold engineering and rough-house testing at Lake X



Power tilt brings stern-drive unit up and out of the water. Dual shock absorbers protect the drive unit from impact; one of them also acts as a hydraulic jack to operate the power tilt.



Button control lets you tilt the drive unit up or down without leaving your seat. It's a handy feature for beaching or shallow-water maneuvering, and gives the driver full control.

and more of them show up at the starting line—and early at the finish line—in such rugged going as the Miami-Nassau race and the Nine-Hour Marathon.

They're also showing up in increasing

numbers in the transoms of boats bought by shrewd pleasure boatmen coast to coast.

MerCruisers have been among the leaders in this astonishingly rapid swing to stern-drive power plants. They come in the



Shoving all three throttles to the wall, Carl Kiekhaefer, head of company that makes MerCruisers, drives experimental boat which is un-

doubtedly the world's highest-horsepowered stern drive. Three big engines, totaling 950 hp., push 31-foot Bertram hull at over 60 m.p.h.

produce handy features, clean design, long use-life



In hub of steering wheel is a geared indicator you'd call a rudder-position indicator—if you had a rudder. It tells direction in which boat will turn. It's invaluable for maneuvering.



Single-lever control of gears and throttle, "Mer-Control," eliminates the sound and jolt of gear shifting. Since engine does all the work, control operates easily. Duals handle twin motors.

largest range of models and are built for the highest horsepower of any of the type. There are seven MerCruiser power packages, for horsepower ranging from 110 to 450 and for either gasoline or diesel power.

The magnificent new III. The MerCruiser III has now moved the stern-drive principle into the realm of practicality for hulls of 30 to 40 feet. It can swing propellers up to 22" in diameter.

Even before this big brother arrived, MerCruisers early this year were being factory-installed in the hulls of more than 130 boatbuilders: in small boats and big boats; wood, metal, and fiberglass boats; in deep-V hulls, flat-planing hulls, special designs, and houseboats. So widespread is their application that, once you decide you want something larger than a canoe, chances are you'll find a just-right MerCruiser to move it.

Why the big shift from through-the-hull shafts? What are the advantages (and disadvantages) of stern drives? That was what I came to find out.

The Lake X testing center covers some 12,000 acres and completely surrounds the lake. Thus there's complete privacy.

Kiekhaefer Corporation's president, Carl Kiekhaefer, showed me around. From the range of boats tested, the instruments used, and the rugged test procedures, it was obvious that these power plants and stern drives are among the most-tested pieces of machinery on the American market.

Six-mile test course. The face of the lake is marked with large white buoys. Test boats travel this 6-mile marked course—

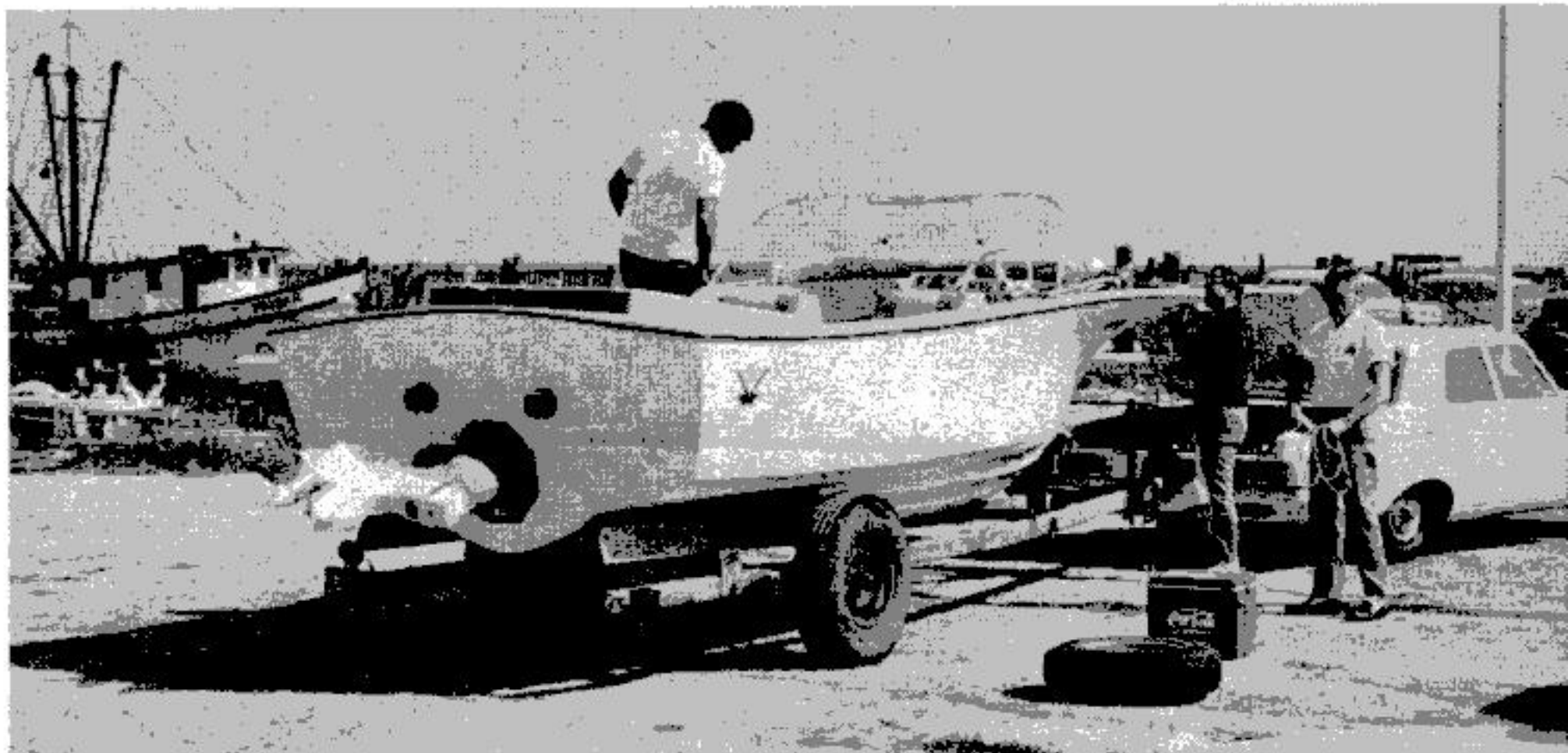


Fuel flow meter on test boat gives fuel consumption in pounds per unit of time. Rates varied with horsepower, but showed all models give inboard economy, outboard versatility.

wide open—24 hours a day, 5½ days a week. They come into the dock area only for fuel and to change drivers at the end of a shift. (Once, as a special test of take-it-ability, two boats were operated *continuously* for 50,000 miles each.)

Tower operators atop Lake X's private guest house monitor the speeding boats and signal the drivers when to come in for fuel

Coast-to-coast across Florida, the scenery changes, but



Launching in Fort Myers was easy. Stern-drive unit, tilted up for highway travel, was lowered into position after boat was backed part way down ramp. Engine was then started, and boat's own power was used to assist in backing the 18-foot fiberglass boat off the trailer.

or new drivers. A series of underwater microphones picks up signals from the speeding boats and automatically records test data on continuous tape recorders.

Heading out. Beginning with the smallest MerCruiser—the 110—in an 18-foot Scottie Craft, I headed out around the test course, then into the center of the lake for acceleration and maneuverability tests. I followed this with the MerCruiser 140 in a 20-foot Powercat, the 190 in an 18-foot Alim, the 225 in a 20-foot Alim endurance boat, the 310-hp. MerCruiser II in a 20-foot Vega, and the new 310-hp. MerCruiser III in a 25-foot Bertram.

After making speed and test runs, I took a fast ride in the famous “52” boat with marathon driver Johnny Bakos. Johnny drove a twin of this 25-foot Bertram—powered by two 225-hp. MerCruiser II units—to first place in last year’s Miami-Nassau race, and second place in this year’s race, on April 25. (He was beaten by Odell Lewis in another MerCruiser.)

Once you’ve decided in which direction you want to aim it, this boat will better 60 miles an hour, with a feeling of complete balance and control.

Then came a big treat. At the outfitting dock was a 31-foot Bertram hull. It’s decked over on the bow but has no superstructure or decking—or even floorboards—

aft of the control station. Neatly mounted aft in her hull was a swarm of power plants: three engines of 300-plus hp. coupled to three MerCruiser II drive units—more than 950 horsepower!

All three engines were fired up and, with Carl Kiekhaefer at the three single-lever controls, we headed out. The boat went up onto plane like a lady and made short work of giving us a close-up view of the other end of the lake. With the Bertram’s deep-V hull, Carl could swing her hard over even at high speed—as he did repeatedly. It was the ultimate ride.

I searched hard for deficiencies—bugs—in all the boats. I didn’t find any. Each boat controlled easily, responded quickly.

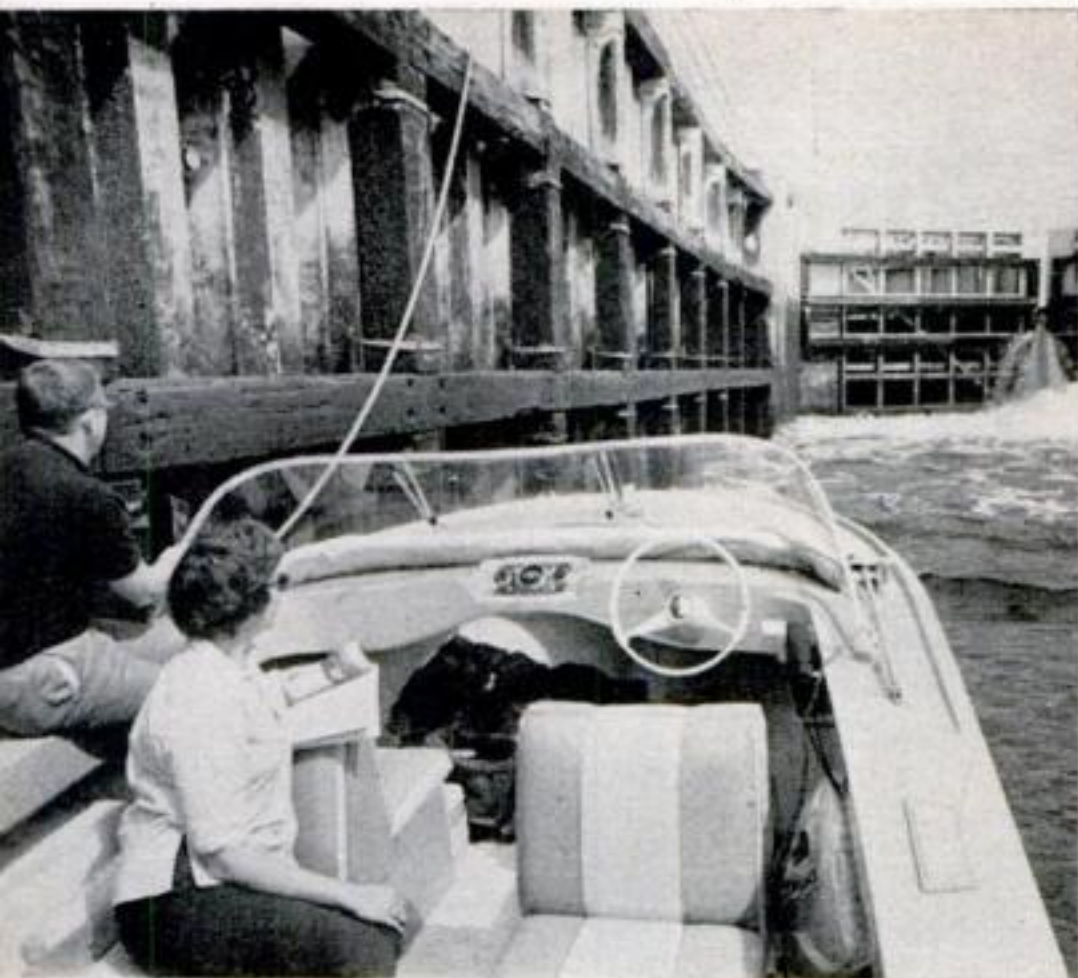
The good points were easy to find. I summarized them that evening as my wife and I flew to the salt-water equivalent of Lake X, the testing station at Siesta Key (Sarasota). My MerCruiser talent list looked like this:

- First, that 20-percent speed increase for the same horsepower. Quite a bonus.

- Outboard trailability for engines of over 100 hp. The MerCruiser stern-drive unit simply tilts up out of the way for trailing, launching, recovering.

- Better steering control. Some inboards don’t start to do what you want them to till long after you’ve spun the wheel. And

the muscular 190-hp. stern drive never misses a beat



Waiting at Ortona Lock—one of three on Gulf-to-Atlantic run. Locks open only certain hours; cross-Florida trip has to be carefully scheduled to avoid long delays, even overnight waits.

they're often hard to maneuver in slow-speed channel and dock-approach situations. The MerCruiser gives you all the power-rudder action of an outboard, because the whole drive unit rotates. It has power backing, too.

- Elimination of several through-the-hull fittings and the frequent trouble they give. There's no shaft log to keep packed, no through-the-hull water intake to keep tightened and unplugged.

- All the breaks if you go aground. Pull this blooper with a normal inboard and you face propeller damage, bent shafts, bent rudders, torn hulls—and the interesting question of how to free the boat. With the MerCruiser, you just raise the drive unit and float free. If the propeller is damaged, there it is right up in the sunshine where you can take it off and install a new one without a haul-out or even wet feet. This is handy for corrosion-proof mooring, too.

- Optional engine location. With the MerCruiser II you can take your pick. The engine can go aft near the transom or, by using a different length drive shaft, can be located forward.

- Economical installation. Instead of carefully aligning a tricky, sloping drive shaft, and installing several through-the-hull fittings, all a boatbuilder need do is provide one single-hole transom mounting.



Looking for rough water—my wife found some on Lake Okeechobee. She handled wheel frequently in rivers and the lake, found the 190-hp. unit as easy to handle as a small outboard.

Three-point mounting makes exact alignment easy to achieve.

- Greater safety from impact damage. Shock absorbers allow the MerCruiser to hit debris—even an opinionated log—without breakage. It simply kicks up and over, then drops down and goes back to work.

That's an impressive list of handy talents.

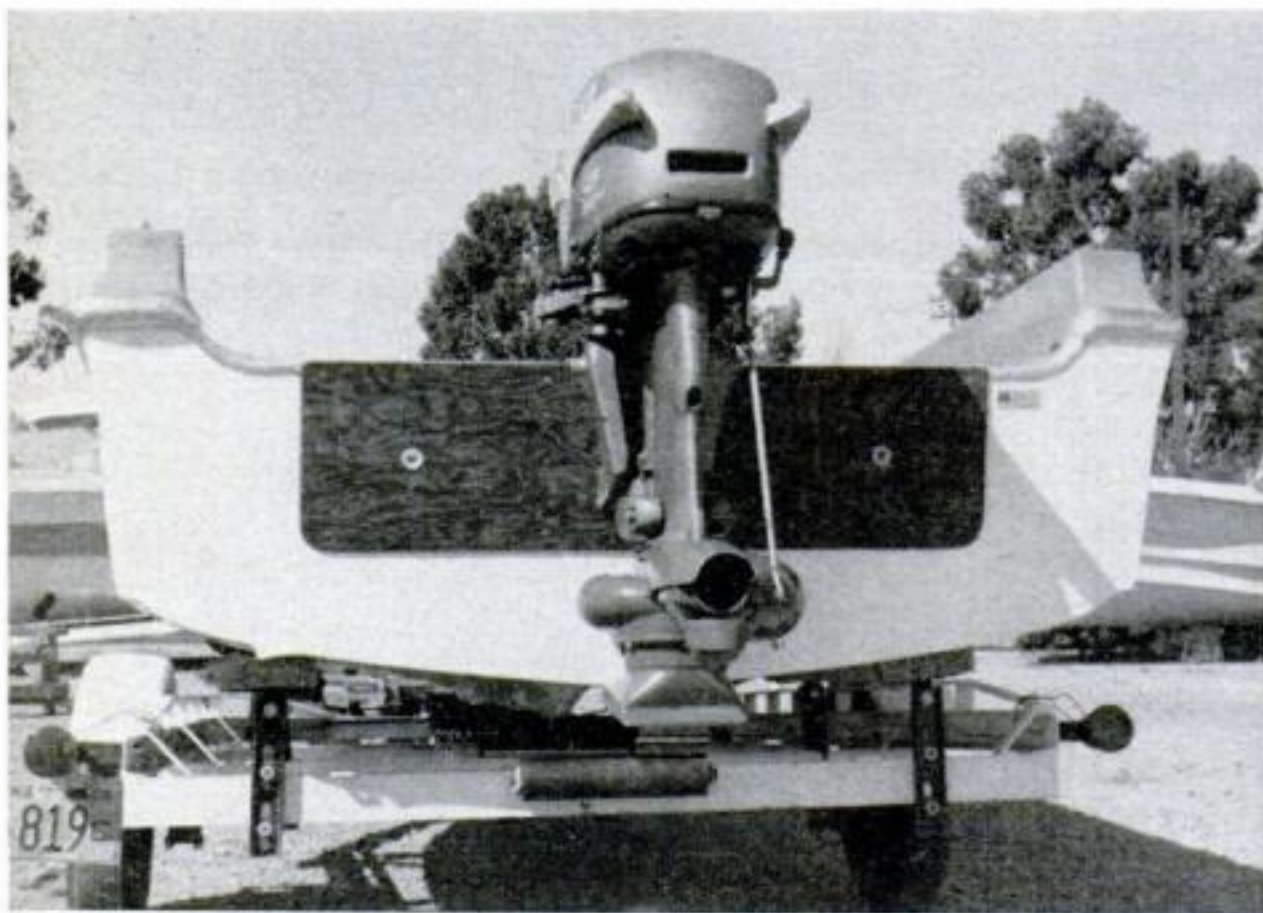
The other side of the coin. What are the disadvantages? I found mighty few. One shows up if the boat is allowed to become unbalanced. If the high-horsepower engine is far back at the stern, and the gas tanks well to the rear, too, the bow is apt to go higher than you'd like as the boat moves onto plane. Once on plane, of course, it comes back down to proper level. Solution: Match the power to the hull, install the tanks forward, or use a longer shaft and move the engines forward.

For the Gulf-to-Atlantic run I selected the 190-horse MerCruiser II in an Alim 18-foot fiberglass hull of deep-V design.

Leaving from Sarasota, I made use of one big advantage: that portability. With winds of up to 60 and 75 m.p.h. reported, I decided the open Gulf run was not for us. Putting the boat on a trailer, we hitched up and made the gusty highway trip to Fort Myers. That's the advantage of a trailable boat: When open water is not a wise

[Continued on page 160]

Now—a Jet Drive for Your Outboard



Nothing extends below the bottom of a boat's hull, as you can see in this installation of a jet-conversion unit on a Johnson outboard. The boat's transom must be built up to reach 20" height. The outlet of the jet is slightly above planing waterline.



An add-on unit you can install yourself will let you go

By Clinton R. Hull

WHY should you want to drive your boat with a jet? With the conversions available for switching many outboards to jet drive, I wanted to find out. Now I was about to get some dramatic demonstrations on why a lot of outboarders will soon be spouting water, instead of spinning props.

Our boat headed full-tilt for white water, and I held my breath. The riffle ahead was

so shallow, I was sure no power boat could make it. I'd watched children wading in it that morning. At no place was it over 4" deep. Seconds later we *had* made it—without so much as bruising a pebble.

This was my first experience with an outboard motor using jet propulsion. We were aboard a 16' Rogue River boat run by Glen Wooldridge, the famed white-water riverman. An ordinary-looking 35-hp. Johnson on the transom hummed its song of power, and we surged ahead as though towed by



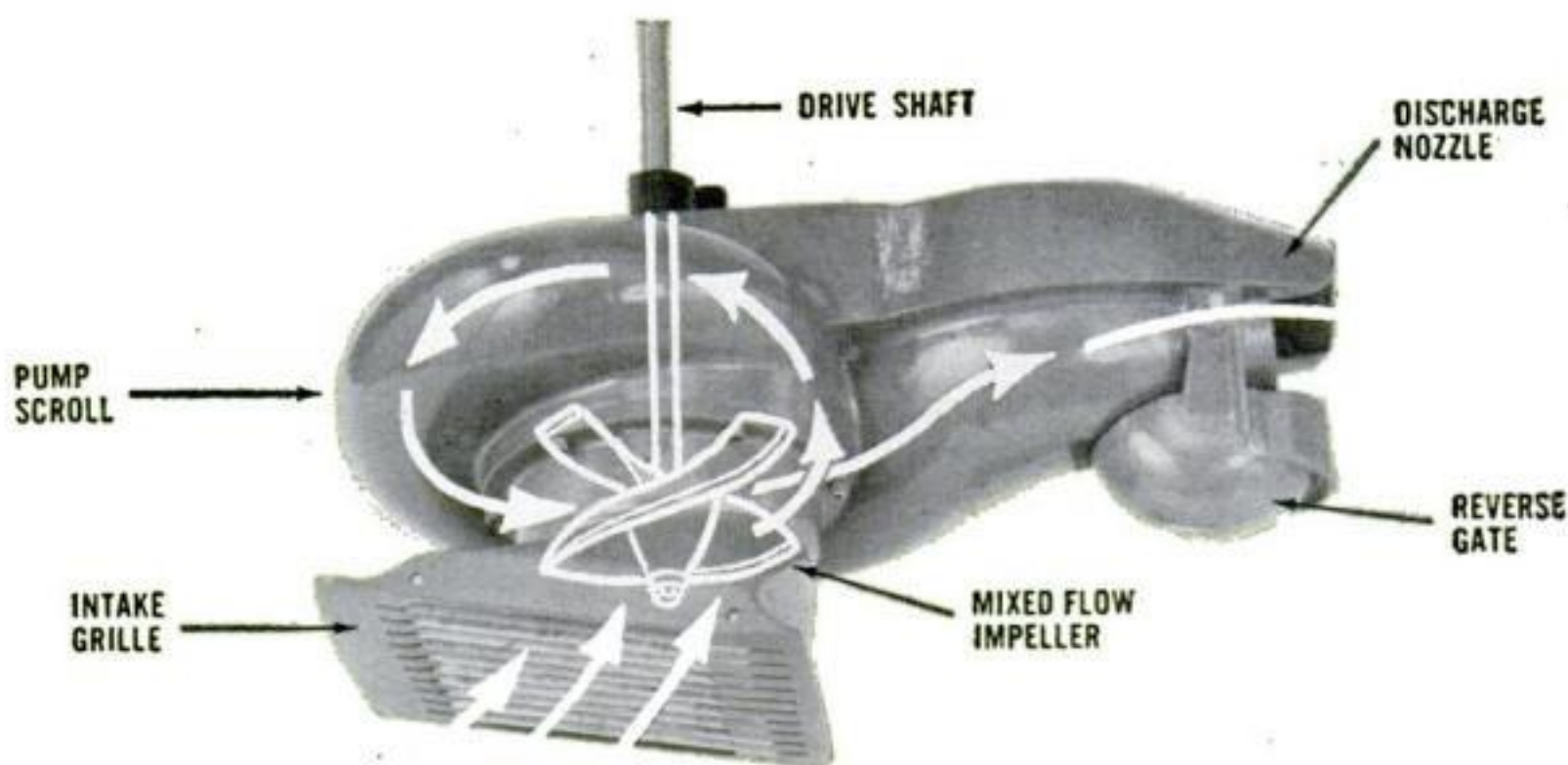
skimming along in any water deep enough to float your boat

an invisible airplane. There was no pre-planing squat of the stern, or sharp up-thrust of the bow when the throttle was first opened. Very little noise came from the motor—which exhausts into the jet—and practically no vibration.

The story behind it all. What lay behind the startling behavior of this boat was the propulsion unit—that Johnson outboard looked ordinary only from topside. In place of the conventional lower unit—gearbox and prop—was a new jet pump made by Out-

board Jets, San Carlos, Calif. They make units to replace the gearbox and prop on nearly all American-made outboards of 25 to 50 hp. and will soon have them for all motors from 15 to 80 hp.

I went to Grants Pass, Ore., to check first hand on whether outboard jets were as good on the water as they sounded on paper. There are few places in the country better supplied with the kind of white-water conditions for which jet drives are uniquely suited. And it would be hard to find experts



Water enters pump through screened intake foot. Mixed-flow impeller (combining axial flow of prop and radial flow of a centrifugal pump) is direct-coupled to motor drive shaft. Forward thrust results from large-volume, high-velocity stream of water projected to rear. Cuplike gate moves to cover nozzle and direct stream forward to give reverse thrust.

Jet drive is easily mounted on your motor, using the existing motor fastenings. Job takes about an hour. Motor is free to tilt in normal manner. Steering and reverse are accomplished with conventional controls. Drive operates above water.

better qualified to judge their worth than the veteran boatmen, like Glen, who ply the Rogue River.

As we cleared that riffle and skimmed the surface of a long pool above it, Glen chuckled at my obvious astonishment. "Hang on," he warned, as he hauled the tiller hard over. "That was just a warmup."

Full blast. The boat banked hard in a sharp U-turn with the motor at full blast. We leveled out on a downriver run and scooted over the riffle again as though we were on skis.

We zipped over turbulent, boulder-studded rapids farther down, banked through another U-turn, and climbed the rapids again with no appreciable loss of speed. Up in the long pool again, Glen released the tiller. The boat stayed right on course.

"Want to try it?" he asked. I nodded and grasped the tiller expecting the usual torque effect. There was none. Wherever I moved the arm, it remained stationary. Nor was there any resistance in a hard turn.

A week later Glen drove the same boat, with a 35-hp. Evinrude, up the Rogue River Canyon, leading one of his 18-footers with twin 25-hp. jet-equipped Johnsons and four passengers. They went up the fabulous Canyon from the sea to Grants Pass without mishap.

These add-on jets use a single-stage, mixed-flow-type impeller. They're made of stainless-steel and aluminum castings throughout, and corrosion-resistant coatings and baked enamel cover the surfaces.

Since wide clearances are allowed inside

[Continued on page 158]

PHOTOGRAPHICALLY SPEAKING

By Bob Hering PS PHOTO EDITOR



Good news for 35mm half-frame users: mounting service

You can now have your half-frame color transparencies returned in 2"-by-2" cardboard mounts. Ansco offers the service at time of processing—at an extra charge. The service charge for a 20-exposure 135 roll (40 half-frame transparencies) is \$1, and includes slide dating and sequence numbering up to 40 slides before repeating numbers.

Two new—and faster—color films

If you're partial to Kodacolor or Ektachrome, you'll be interested in two new film emulsions—Kodacolor-X and Ektachrome-X. Both films are rated at 64 ASA—twice as fast as the old ones. The increased speed gives you a chance to take pictures under conditions that previously were difficult or impossible. Also, with the new films, blue flashbulbs and electronic flash are more effective at greater distances. The films are slightly sharper, too.

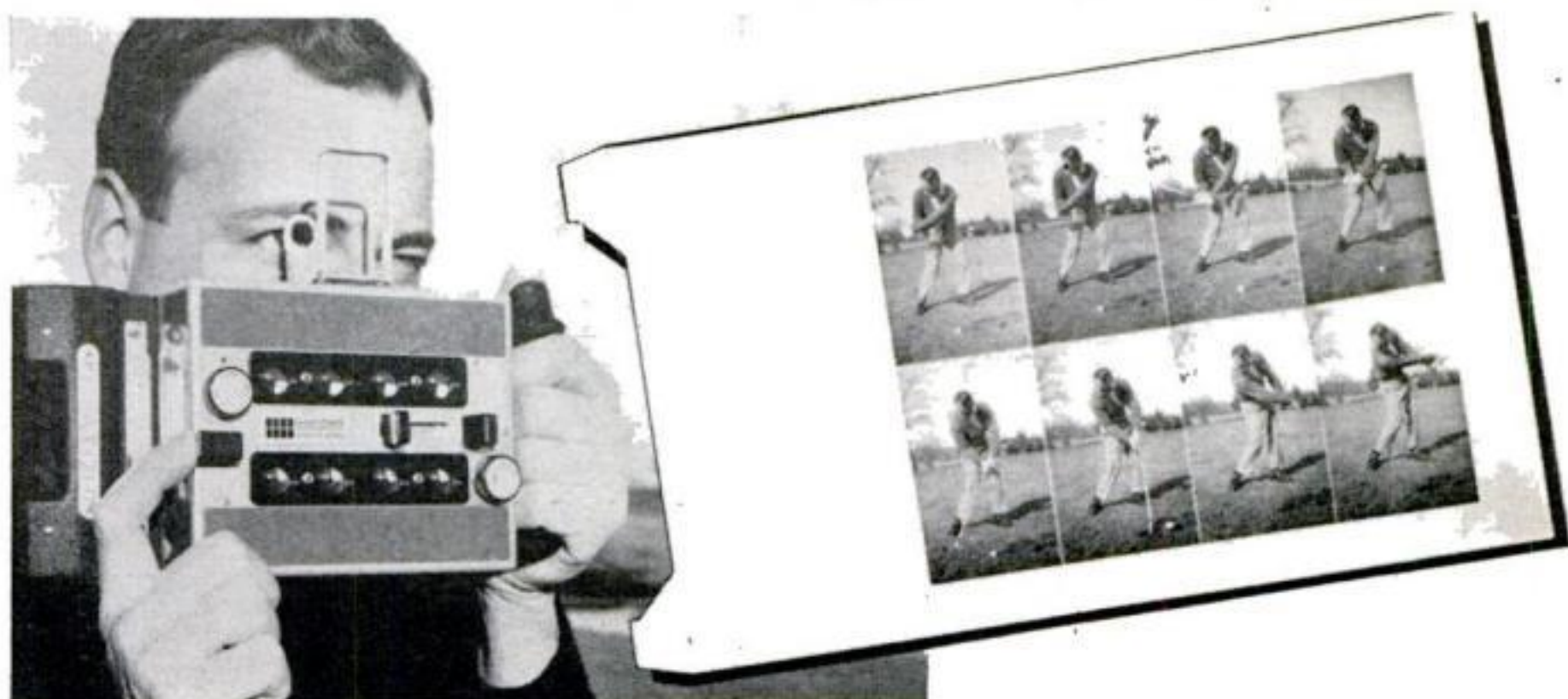
Ektachrome-X replaces regular Ektachrome. You'll find the colors brighter in this new daylight color-slide film.

Kodacolor-X, a color-negative film, replaces Kodacolor only in the 135 size. You can get prints or transparencies from it.

Eight-lens camera catches sequence-action pictures

Talk about unusual cameras, the new Graph-Check sequence camera built around the Polaroid 4"-by-5" film holder has eight separate lenses winking at you. All the photographer does is aim and shoot. Operating in automatic sequence, the shutter clicks off eight exposures at 1/1,000 second. It makes possible photographic analysis of high-speed motion within seconds after an event.

It's an effective training aid for all outdoor sports. Probably not a camera you and I would buy to improve our golf game—the price tag reads \$395—it's an interesting one to tell your club pro about.



What's New at the Camera Shows

By Bob Hering

EVERY spring the photographic dealers and manufacturers get together to look over the new photo equipment. This year the big shows were the Photokina in West Germany, the Master Photo Dealers and Finishers show in Atlantic City, and the International Photo Fair in the New York Coliseum.

Looking over the new crop of equipment left me impressed by the interesting new trends and the direction in which photography seems headed. Here's the run-down:

- Film cartridges and self-threading movie cameras are simplifying loading.
- Still cameras continue the big swing to automatic controls.
- Half-frame 35mm cameras are bidding for increased popularity.
- Electric-powered photo equipment is coming up strong.
- Built-in supersensitive CdS photo eyes are rapidly replacing the less-sensitive selenium cells in both still and movie cameras.

lenium cells in both still and movie cameras.

● Book-size 8mm automatic movie cameras are starting to dominate the moderate-price field.

With all the power controls and automation built into cameras these days, picture taking gets easier and easier. If you hesitate to shoot pictures because you don't want to bother with the mechanical side, get acquainted with the new way: drop in a film cartridge, aim, and shoot.

Preloaded cartridges. Getting a mighty push this year, they include both the unexposed and take-up rolls in a single light-tight unit. You get the convenience of 8mm magazine loads with the economy of roll film. You can preload cartridges with roll film in subdued light, carry them with you, and drop them in as needed. To change sides, you flip the cartridge and re-insert. Or you can switch to a different film once you complete a side. The cartridges eliminate rethreading in the middle of a roll and the possibility of light flare. Pressure plates keep the film flat for maximum sharpness.

Eastman Kodak introduced their first cartridge movie camera last fall. It had a fixed-focus lens and motor-driven film advance. Now they're marketing a second cartridge-load camera—the Electric 8 with zoom lens (photo 3), which sells for about \$150.

Bell & Howell displayed a new autoloader cartridge camera in their Optronic Eye line. The sides of the cartridges are numbered, and a window in the camera door shows the number of the side last exposed. For the zoom lens, there's through-the-lens reflex viewing. The zoom position is indicated in the viewfinder. Price of the camera: about \$250.

The 126 Kodapak cartridges used in



1. Yashica Mimy is typical of the new half-frame 35mm cameras introduced this year.

World's largest photographic show, the international Photokina, is held every two or three years in Cologne, West Germany, and spreads over nine halls such as the one shown at right.

Kodak's new line of Instamatic still cameras are unique. They're throw-away plastic units—the processor breaks them open.

Similar in convenience to the cartridges are self-loading cameras such as the DeJur EF-40 8mm, which automatically power-loads film onto the take-up spool. You drop a roll into place, close the door, and you're ready to shoot. The Carena Zoomex uses a self-loading system, too.

Half-frame cameras. As new controls have been added, 35mm cameras have taken on bulk. This brought a new trend: using the same size film but shooting half-frame (or single-frame, as it's also called) 35mm pictures—72 pictures on a 36-exposure roll. It reduces the overall size while still retaining the advantages of 35mm film. Yashica is showing two new half-frame cameras, its Yashica 72 Mimy (photo 1) and 72E, both with a low price tag of about \$45. The Mimy automatically sets exposure.

Agfa also showed two half-frame pocket cameras (18-by-24mm negatives). The Parat I uses scale or symbol focusing, with shutter speed and lens opening visible in windows. Their other half-frame camera, Agfa Paramat, has automatic aperture control; it disconnects for flash and time exposures.

Canon has the new half-frame 35mm Demi camera with a programed shutter (1/30 to 1/250) and a diaphragm coupled to a built-in exposure meter.

A new 16mm subminiature, the Rollei 16, made its bow (photo 2). This one is 1½" by 1¼" by 4¼", fully automatic, and is programed for the best combination of aperture and exposure speed (1/30 to 1/500). The lens is an f/2.8 Zeiss Tessar. When available, the camera will be tagged at about \$150.

CONTINUED



2. Rollei 16 subminiature (left) is new German entry.
3. Kodak Electric 8 Zoom is cartridge-loaded.



WHAT'S NEW AT THE PHOTO SHOWS



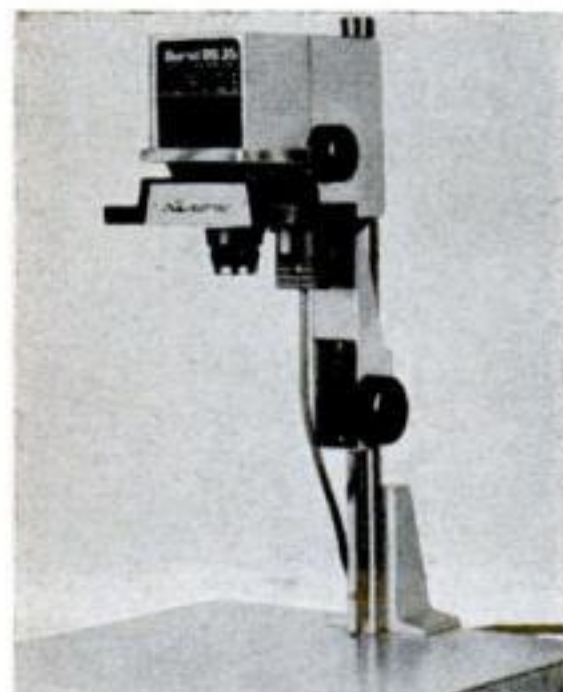
4. Canon Cine Canonet 8.



5. Yashica E twin-lens reflex.



6. Anso Cadet II outfit.



7. Durst Newporter enlarger.

The shift to automated cameras, which has been going strong for some time, continues at a fast clip. The Canonet 2.8 35mm (photo 9) is typical. It automatically selects the coupled aperture and shutter speeds. The price with case and flash unit is about \$100. For flash exposures, you line up the estimated camera-subject distance with an arrow on the aperture ring. You can also shift quickly to manual control. These features are fast becoming a standard in the industry.

One hit at the Photokina was the Japanese Canon 35mm Auto-Focus camera. Its automatic focusing system represents a major breakthrough in automatic controls. The camera also sets aperture and shutter speed by itself, and winds the film after each exposure, too. It won't go to market until the fall of 1964.

Among medium-price, semiautomatic cameras is the new Ansco II, listing at \$85. The lens opening and shutter speed are set by moving a single ring. You also turn the ring to make automatic flash-bulb settings.

Another new semiautomatic is the compact Zeiss Contessa LKE (photo 8) with the reliable Tessar lens. Its photo-electric meter couples to a matching-needle scale. A single movement sets the correct combination. You can have one of these for \$109.

Anso showed a new easy-to-handle travel kit (photo 6). It's the Cadet II camera in a luggage-type carrying case. At \$14 it makes an excellent inexpensive gift for a teen-ager.

The new Rollei Mutar tele and wide-angle lens systems are front lens attachments developed jointly by Rollei and Zeiss. They are quality optical systems that change the basic focal lengths by a factor of 1.5 or 0.7 for moderate tele and wide-angle effects. The viewing and taking lenses bayonet as a unit onto the camera lens.

Latest addition to the Yashica 120-size twin-lens reflex cameras is the Yashica E (photo 5). It uses a fixed 1/60 speed with automatic exposure control. The electric eye automatically compensates for a filter when it's in place. Cost: about \$55.

Battery power. Manufacturers keep finding more uses for those tiny, long-life batteries. This year may be a record one in the general shift from manual controls to battery-powered controls. It's now standard to power movie cameras with motorized film advances.

Along with battery power, remote-control outlets are appearing on most movie cameras. You can now operate the film advance and power-zoom lens without getting near the camera. The setup is particularly useful for nature and trick photography.

The popularity of the supersensitive cadmium sulfide (CdS) cell has increased rapidly, especially for movie cameras. It may soon replace the less-sensitive selenium cells, except on the budget-priced models. But unlike the selenium cell, the CdS cell needs batteries to supply power to move the exposure needle. It acts as a variable resistor, changing with the amount of light falling on it.

We've had CdS cells for some time, but their use was con-

fined to large, separate meters. Now they're on several moderately priced movie and still cameras. Look for this to become standard by next year.

In movie cameras, the trend to compact designs continues. While 35mm still cameras are bulging with new automatic controls, movie cameras keep getting more compact. Several are about the size of a book. Designs are smoother and trimmer than the ones you're used to seeing.

Typical of the compacts is the Revere 98—about the size of a 1½"-thick paperback book. It's run by an electric motor, and a CdS electric eye automatically adjusts the aperture. The camera lists at \$115. A reflex viewfinder lets you see the scene as it will appear on the film.

Bell and Howell's new compact is the Canon Cine Canonet 8 (photo 4) with a zoom lens, CdS automatic exposure control, single-lens-reflex viewfinder, remote-control socket, battery-drive film advance, and a \$150 price tag.

For about \$50, you can get the compact Vernon 8, billed as the box camera of the movie field. Look what it includes: electric-motor drive, coupled exposure meter for automatic exposures, a fast f/1.8 fixed-focus lens, and a built-in pistol grip. It even has a remote-control outlet.

The new movie projectors. Auto-loading and -threading are coming along strong. The new Keystone K-980ZV (about \$125) threads the film automatically through the entire projection system and loads it onto the take-up reel without a hand touching it. The projector includes a zoom lens, another convenient feature that's showing up regularly.

Many of the new projectors have streamlined, compact bodies housed in cases that are part of the body itself, making them easy to carry and store.

A new high in automation and convenience is reached by the current crop of slide projectors. Generally operation is semiautomatic. But many give you a choice: semi or fully automatic or manual. Remote-control units are now common over a wide price range.

Sawyer's Rotomatic (photo 11) offers four different slide-handling methods. The Rototray holds 100 slides and adapts to all Sawyer 500 projectors. Besides the circular tray, the Rotomatic can use: a new stack loader that handles 40 slides without a tray, an inexpensive TDC-type tray, or a tray with top access. The Rotomatic is \$129.50.

Airequipt showed a convenient new slide-handling system (photo 10) for moving slides from a storage unit to the projector. The Autostack loads up to 72 slides at a time. Picking up the slides from their compact case—which holds up to 650—the handler drops them into a magazineless projector. The complete kit sells for about \$70.

Something for the darkroom caught my eye, too. The new Durst Newporter 35mm enlarger-copy camera (photo 7). The enlarger sets up in seconds and folds into a minimum space. It supplies a need for the man who wants an enlarger but can't have a permanent darkroom. Stored in its fitted styrofoam container, it measures 15" by 15" by 6¼". You can make 10"-by-15" prints on the baseboard. By reversing the front condenser-mirror housing and adding a 35mm copying cassette, the enlarger becomes a reflex copy camera. Price without lens: \$54.95. ■ ■



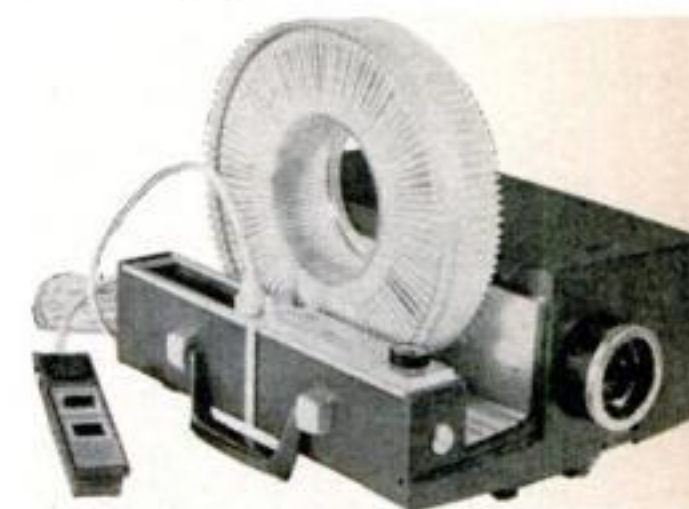
8. Zeiss Contessa.



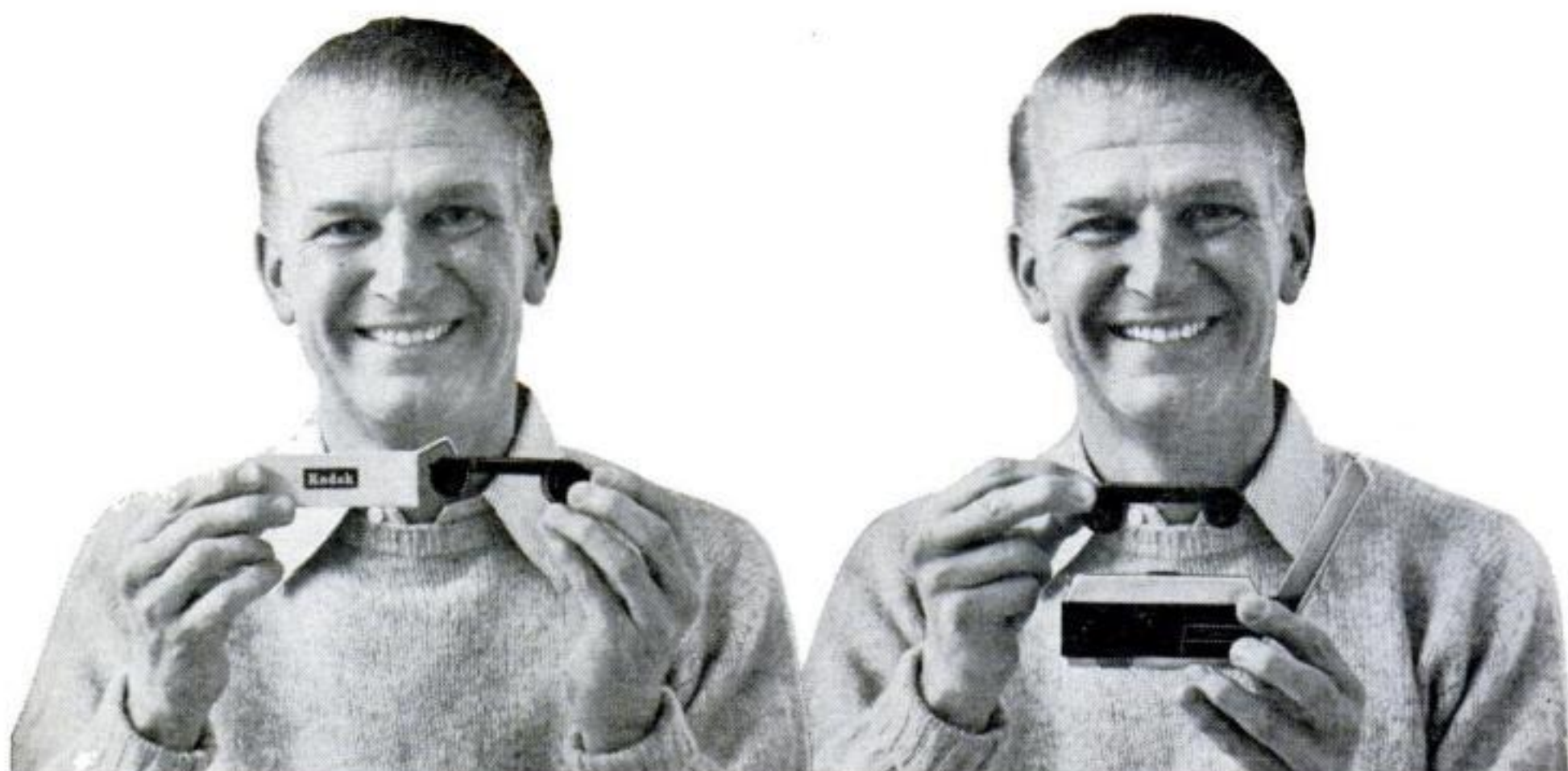
9. Canon Canonet 2.8.



10. Airequipt Autostack



11. Sawyer Rotomatic.



Now! Instant-loading cameras

New KODAK INSTAMATIC

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New KODAK INSTAMATIC Cameras take care of practically everything automatically. All you do is shoot. Get sharp, bright prints in color or black-and-white, or color slides.

There are four KODAK INSTAMATIC Cameras. Their features range up to automatic electric-eye exposure control, automatic film

advance, and fast lens-shutter combinations.

Model 400, shown at right, gives you automatic electric-eye exposure control *and* power-drive film advance. It lets you fire off 10 shots without lowering the camera from your eye. The electric eye not only sets the lens, but also signals in the viewfinder when to use the built-in flash. The INSTAMATIC 400 Camera is all brain, yet weighs only 15 ounces, is just 4 inches wide! INSTAMATIC 400 Outfit with bulbs, batteries, film—less than \$53. At your Kodak dealer's now!



KODAK INSTAMATIC 100 Outfit. Instant-loading camera with built-in flash. No focusing, no settings. Outfit: film, bulbs, batteries—less than \$16.



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KODAK INSTAMATIC 700 Camera. f/2.8 lens, automatic day-light and flash exposure controls, built-in flash, speeds to 1/250. Available soon.

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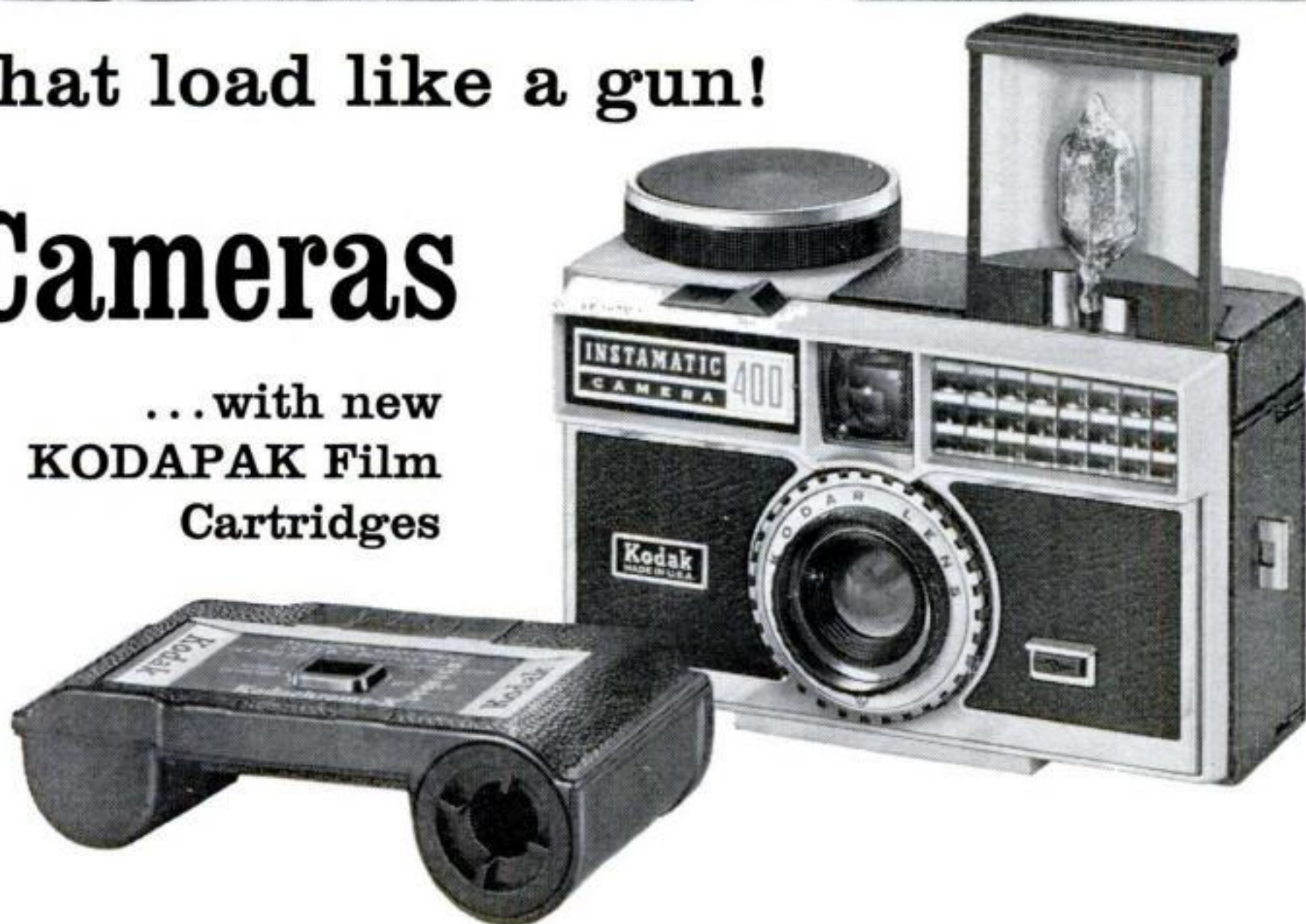
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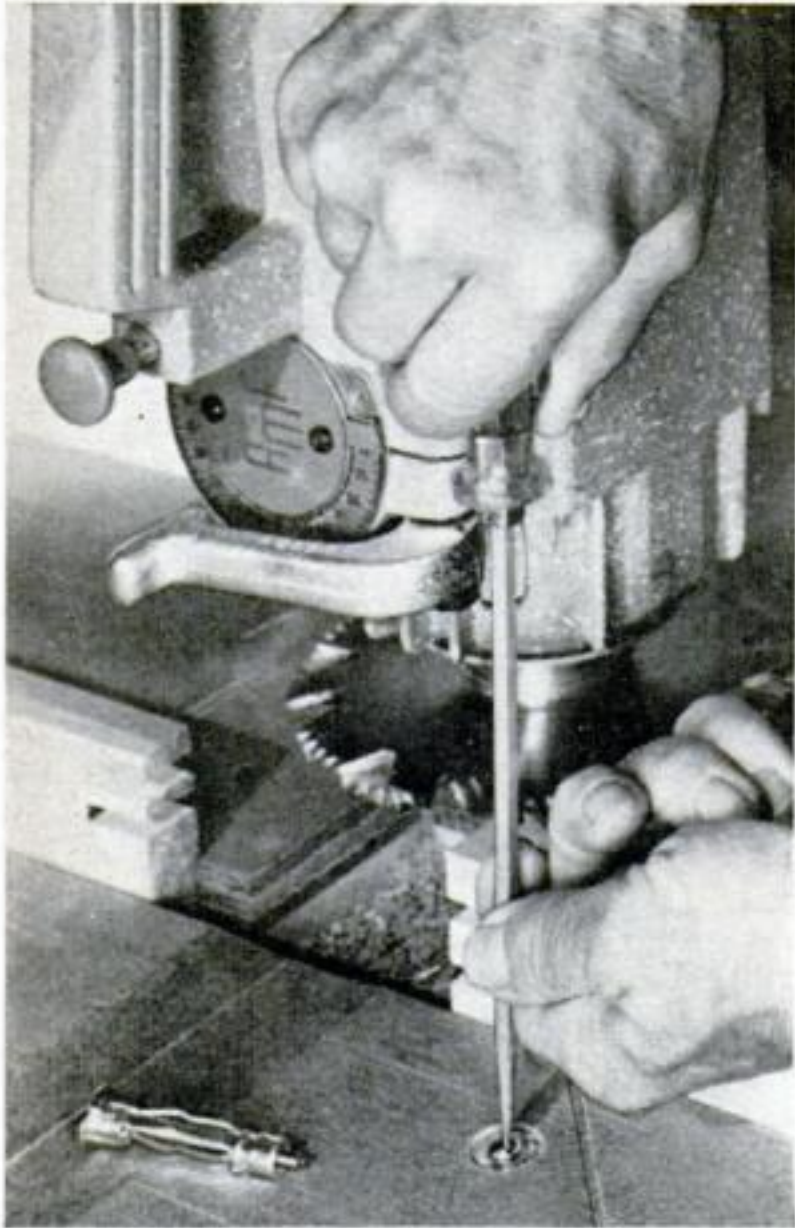
New ready-loaded KODAPAK Film Cartridges are designed specifically for use with the KODAK INSTAMATIC Cameras. They drop in instantly — no threading, no mistakes. You can even put them into the camera in bright sun. Choose cartridges of KODAK VERICHROME Pan Film for black-and-white shots. Choose cartridges of KODACHROME-X or KODAK EKTA-

CHROME-X Film for color slides; KODACOLOR-X Film for color prints. (All are fast films, to let you shoot in less light. See your Kodak dealer for details.)

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Anchors for Radial-Saw Work



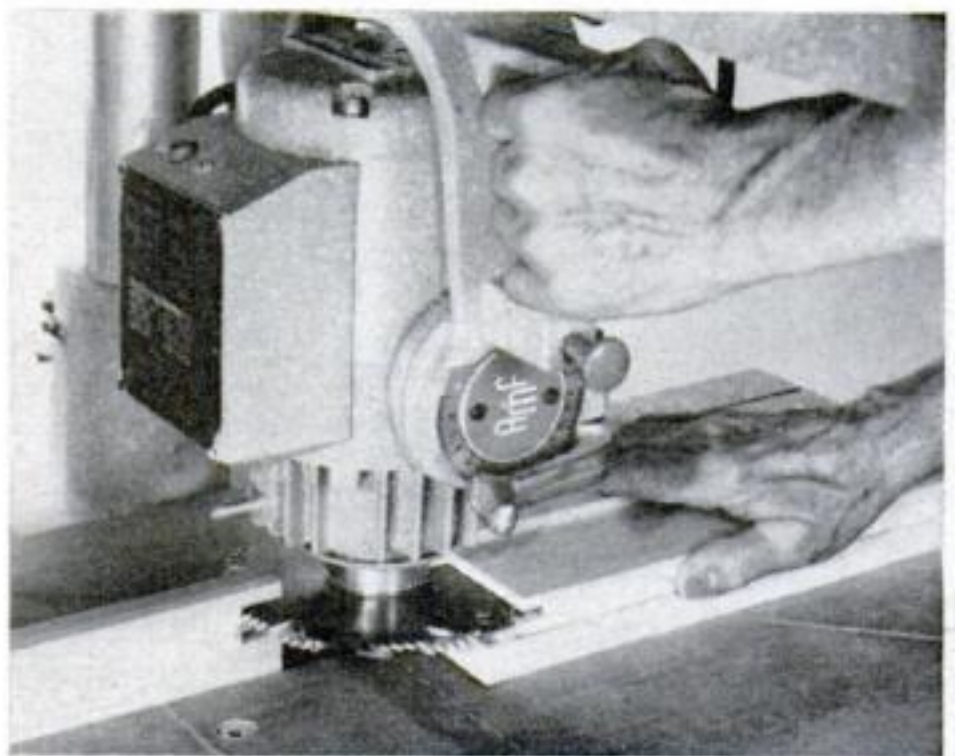
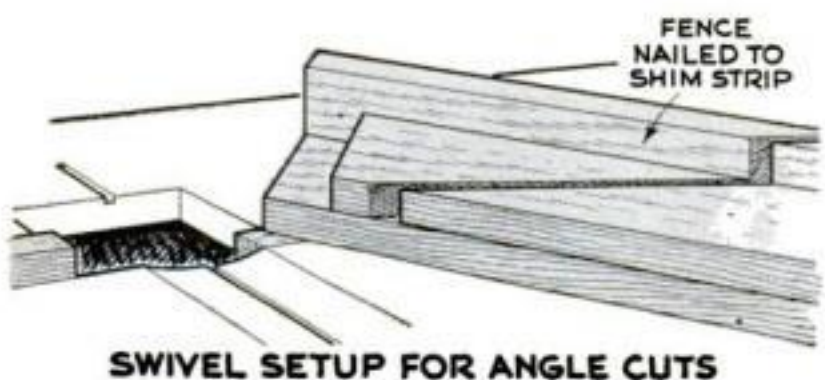
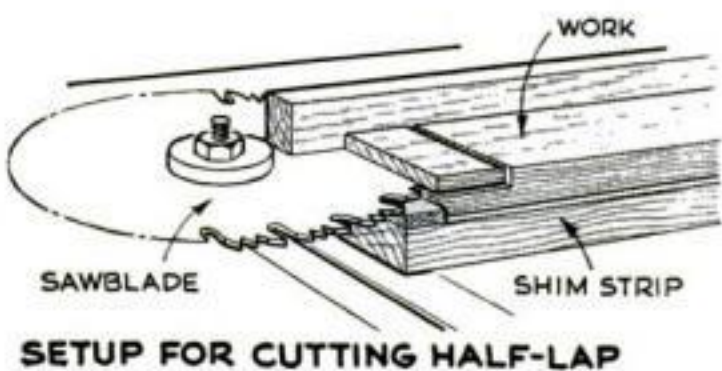
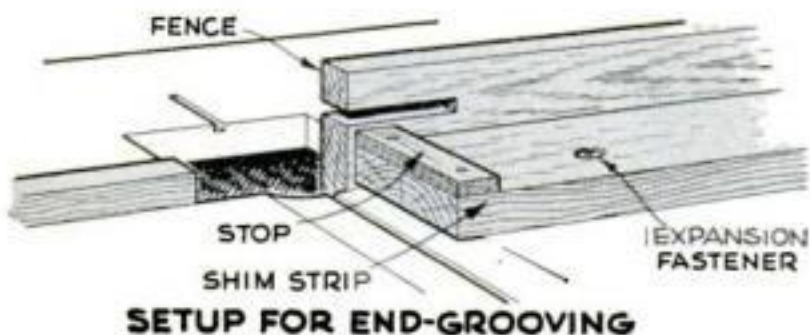
Expansion fasteners are set into the saw table wherever needed. Counterbore the table to sink the fasteners below the surface so they can't interfere with other operations.

EXPANSION fasteners set into a radial-saw table will hold auxiliary tables, fences, and similar accessories for special and production cuts. Located near the work center, they eliminate table-edge clamping and prevent springing of the support under the saw.

To install fasteners, counterbore the table to sink them; then bore holes to fit the shanks. Drive them in, turn down the screw as far as possible, and fold the split shanks under the table to lock in the nuts. Remove screws when not in use and keep them handy, taped to the top of the track arm.

You'll find innumerable uses for these anchors. I've used a shim strip clamped to the table to support a cabinet-door rail for end-grooving. With a similar setup, you can use a standard blade instead of dado saws for making half-lap joints. Shoulders are cut before or after cheek ripping.

Mitering strips at acute angles beyond the swing of the arm is easy with an auxiliary table or shim strip that has a fence at its rear edge. Pivot it on a screw and hold it in position with a block clamped to the table behind the forward end.—*E. M. Love, Palmdale, Calif.*



For end-grooving, work rests on a shim strip screwed to anchor. Height permits motor shaft to clear table top as saw moves. Strip of plywood nailed to end of shim strip is depth stop.

New 75 hp Sea-Horse
Electramatic motor



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On your mark. Get set. Go Electramatic!

Most responsive outboard ever built! Now with a 2-year warranty!

At dockside: crisp, clean, sleek . . . the look of power. At throttle: taut, eager, whip-quick . . . 75 horses you can stampede or stop with one hand. A seagoing V-4. Rugged. Responsive! Electramatically responsive . . . with a revolutionary new electric clutch. One lever for forward or reverse. Works automatically, instantly. More? An alternator-generator, 20 amps. A super silencing system. Plus stay-new styling. And deep-root dependability. All wrapped in the industry's first and finest two-year warranty policy. Complete. Parts *and* labor. Your Johnson dealer is in the Yellow Pages. '63 Sea-Horse motors: 75, 40, 28, 18, 10, 5½ and 3 hp models. Free catalog. Johnson Motors, 1365 Pershing Road., Waukegan, Illinois. Division of Outboard Marine Corporation.

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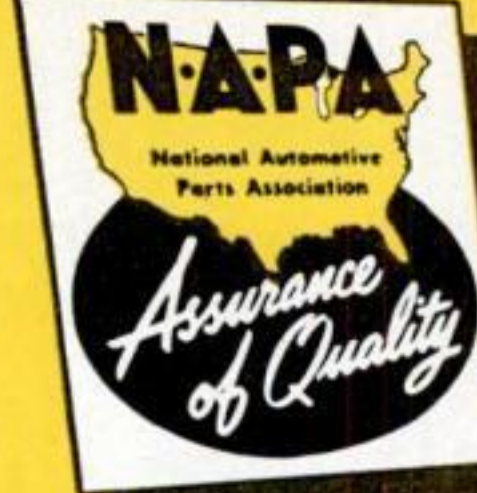
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Yes...*Look For This Sign* to keep your car in top condition always and everywhere. It's the sign of Superior Service with Quality Parts, displayed by good service-repair shops all over America. These service shops are backed by the technical facilities and supply network of the largest independent parts distributing organization in the world—NAPA. 46 strategically located Warehouses and over 3,500 Distributors combine to speed needed parts to your service-repair shop—the quality parts made by the famous manufacturers whose brands are featured below. For your car...for your truck...for your peace of mind...for your purse...*Look For The NAPA Sign of Good Service!* N·A·P·A, 29 East Madison Street, Chicago, Illinois.

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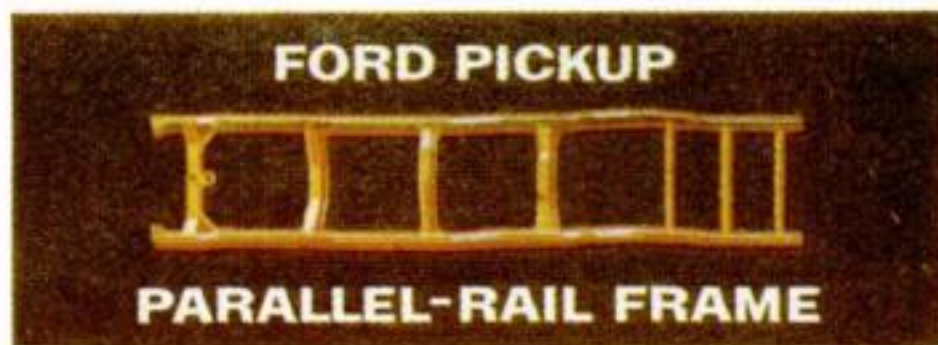
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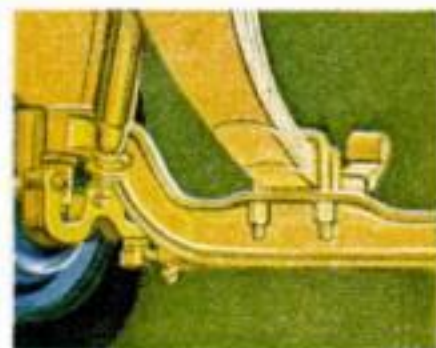
Built like the big ones from the frame up...and from the frame down !

'63 FORD PICKUPS



Comfort-Conditioned Custom Cab puts 5 inches of foam cushion beneath you . . . 27 pounds of insulation around you for a softer, quieter ride!

BUILT LIKE THE BIG ONES FOR BIG-TRUCK DURABILITY !



I-Beam Front Axle maintains front-end stability on roughest roads. Front wheels track truer . . . tires last much longer. Tests prove it!



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Don't be misled by the smart looks—or by the smooth ride. Under the solid comfort of new Ford pickups lies solid truck!

Wherever toughness counts, Ford pickups give you the durable design of big trucks. This means extra freedom from breakdowns and repairs. It means a truck that holds up on your job—and holds costs down! Look into and *under* a '63 at your Ford Dealer's!

FOR 60 YEARS THE SYMBOL OF DEPENDABLE PRODUCTS  MOTOR COMPANY

FORD TRUCKS For Outstanding Reliability & Durability

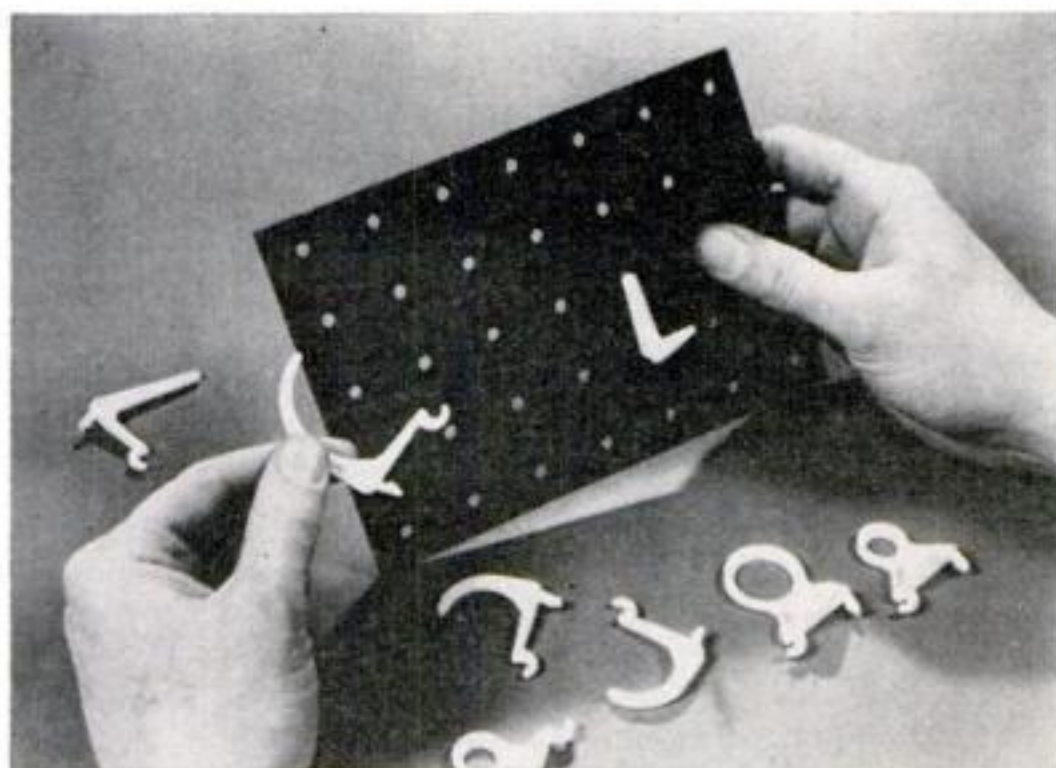
Jig Centers Holes in Round Stock

DRILLING precise holes in round stock is easy with this centering jig. It's a pointed, spring-loaded rod that chucks in a drill press in place of a bit. You punch-mark the work and lower the rod until its point just touches the punch mark. A V-notched collar is then slid down the rod onto the work. If the work is off center, the notch won't fit over it (drawings at right), and you move the work until the notch clicks into place. Now, with the work centered, you clamp it and replace the rod with a drill bit. \$4.95 from Ethical Enterprises, 988 U.S. Highway 202, Somerville, N. J.

Drill holder puts bits at your fingertips

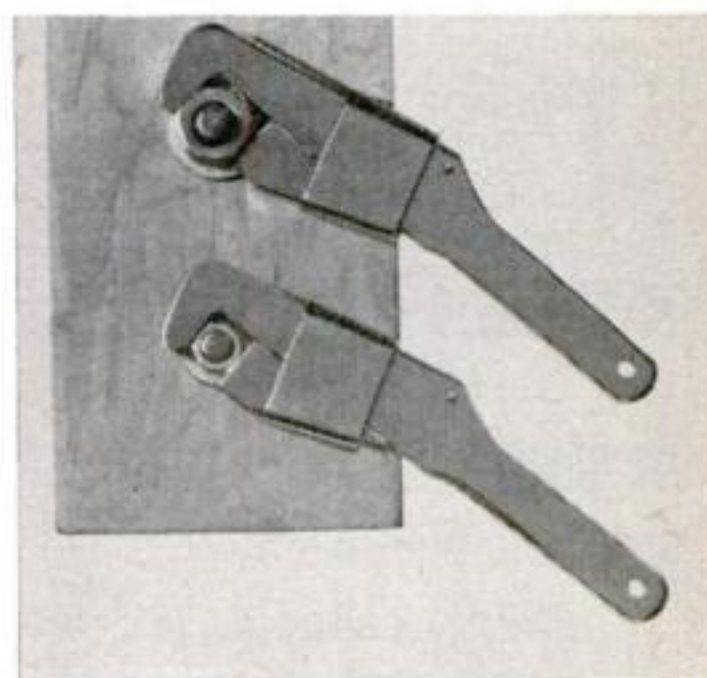
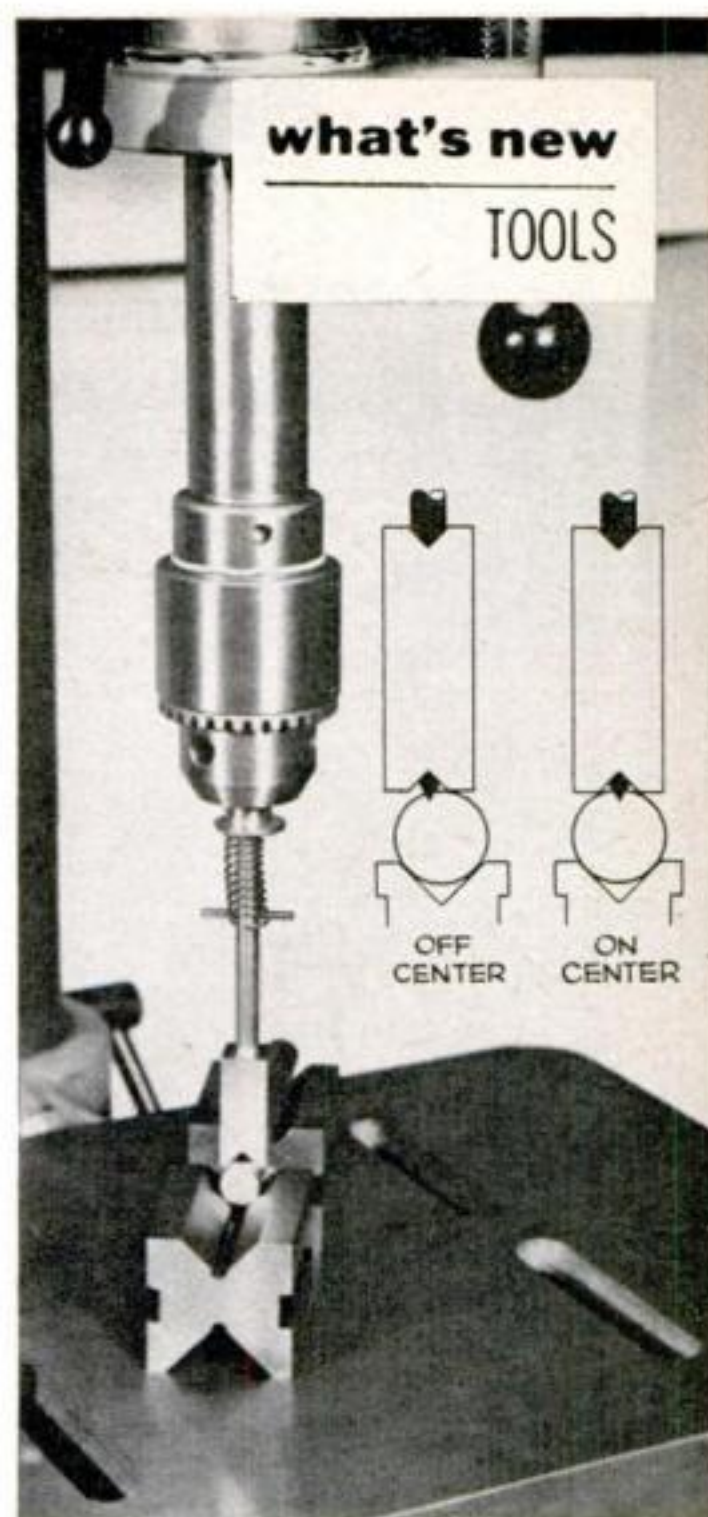


Drill bits are always within easy reach with this rotating holder for a drill press. It clamps to any 2 3/4" column and holds 118 bits. It can also be mounted on a wall or bench. \$9 from Cardona Co., 6867 Farmdale Ave., North Hollywood, Calif.



Plastic tool hangers grip in any position

These Masonite tool hangers snap into perforated board and hold snugly in any position. They're made of resilient Delrin plastic, which provides a strong wedging action to lock them in. You can mount them sideways, even upside down, to create a variety of tool-holding arrangements.



One-hand wrench adjusts itself

Just slide the collar along this wrench with your thumb and the jaws automatically adjust to any nut size up to 3/4". The lower jaw is movable and is shaped like a wedge. When a nut is gripped, the jaw jams tightly inside the collar. To loosen, slide collar back. \$2.98 from Empire Mdsg. Co., 140 Marbledale Rd., Tuckahoe, N. Y.



Fitted with a telescopic sight, Remington's new XP-100 looks more like a short rifle than a conventional pistol. Rugged rifle-type bolt action is needed to withstand tremendous firing pressures that build up in the receiver.



Why the XP-100 is so hot: Muzzle velocities tell the story. Note how the new 221 cartridge



NEW 221—2,650 ft./sec.



.30 LUGER—1,220 ft./sec.



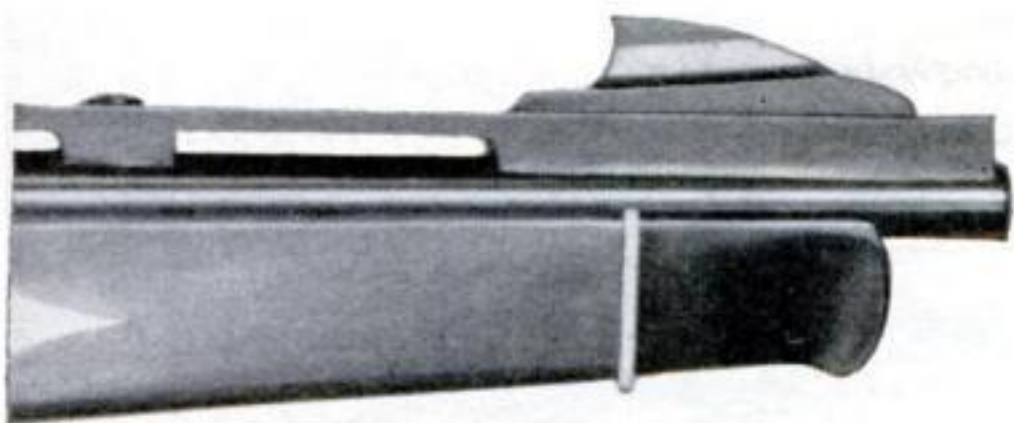
.32 S&W LONG—780 ft./sec.

New epoxy coating waterproofs shower walls

THERE'S a new moneysaving finish for bathroom walls that get sprayed or splashed with water. It goes by the fancy name of catalyzed epoxy coating, but it goes on like paint. When it hardens, you'll be willing to bet your neighbor he couldn't

tell it from a porcelain surface. It acts like one, too. It will make plaster or plaster-board walls absolutely impervious to water. Your wife can scrub it just as she does ceramic tile. Colors? About a dozen to date, with additional tints possible when white or black is blended.

Here's how it works: When you buy a quart, you get a half-filled quart can of color base and a pint can of activating



World's Hottest Handgun

Long-range accuracy and a high-powered shell make the new XP-100 a deadly shot

TAKE a high-powered rifle, shorten the barrel a bit, replace the shoulder stock with a pistol grip, and you have the hottest handgun ever made. Designated the XP-100, it's Remington's answer to the growing popularity of small handguns in varmint hunting and target shooting at unbelievably long ranges.

While 25 yards is a good range for most pistol shooting, the new XP-100 can zero in on targets up to 300 yards away (that's three football fields laid end to end). The secret is an unusually long barrel—10½"—combined with a brand-new souped-up cartridge made especially for the gun. The cartridge, called the Remington 221 Fire Ball, is nearly 2" long and packs a muzzle velocity of 2,650 feet a second—more than 30 miles a minute. This is two to three times faster than conventional pistol car-

tridges and even outdoes many rifle cartridges.

Everything about the gun is designed for maximum accuracy, simplicity, and ruggedness, with few frills. You load and fire one shot at a time. You work a heavy bolt that is almost exactly like a conventional rifle bolt. The sights, also like a rifle's, are adjustable for both windage and elevation. For superaccuracy, you can even add a telescopic sight.

Overall length is a whopping 16¾", but is nicely balanced by the long overhang at the rear of the grip. Despite its massive appearance, the gun weighs only 3¾ pounds. One reason is a lightweight stock of molded Zytel nylon. Unlike wood, it can't warp or shrink and is designed to keep the barrel perfectly aligned. Price of the P-100 will be \$99.95.

at far left way outfires any standard pistol cartridge. All cartridges are shown actual size.



.38 SPECIAL—855 ft./sec.



.44 MAGNUM—1,470 ft./sec.



.45 COLT—855 ft./sec.

resin. Thirty minutes before you paint, mix the contents in a 1:1 ratio. Stir with a wood stick. When the 30 minutes is up, flow the coating on with a brush (natural bristles only) or a roller. Don't brush it out or you'll get streaks. You can spray it on, too. But the sprayer gets pretty gooped up, so unless it's a huge job, better stick to the brush or roller.

To clean your brush, use the special

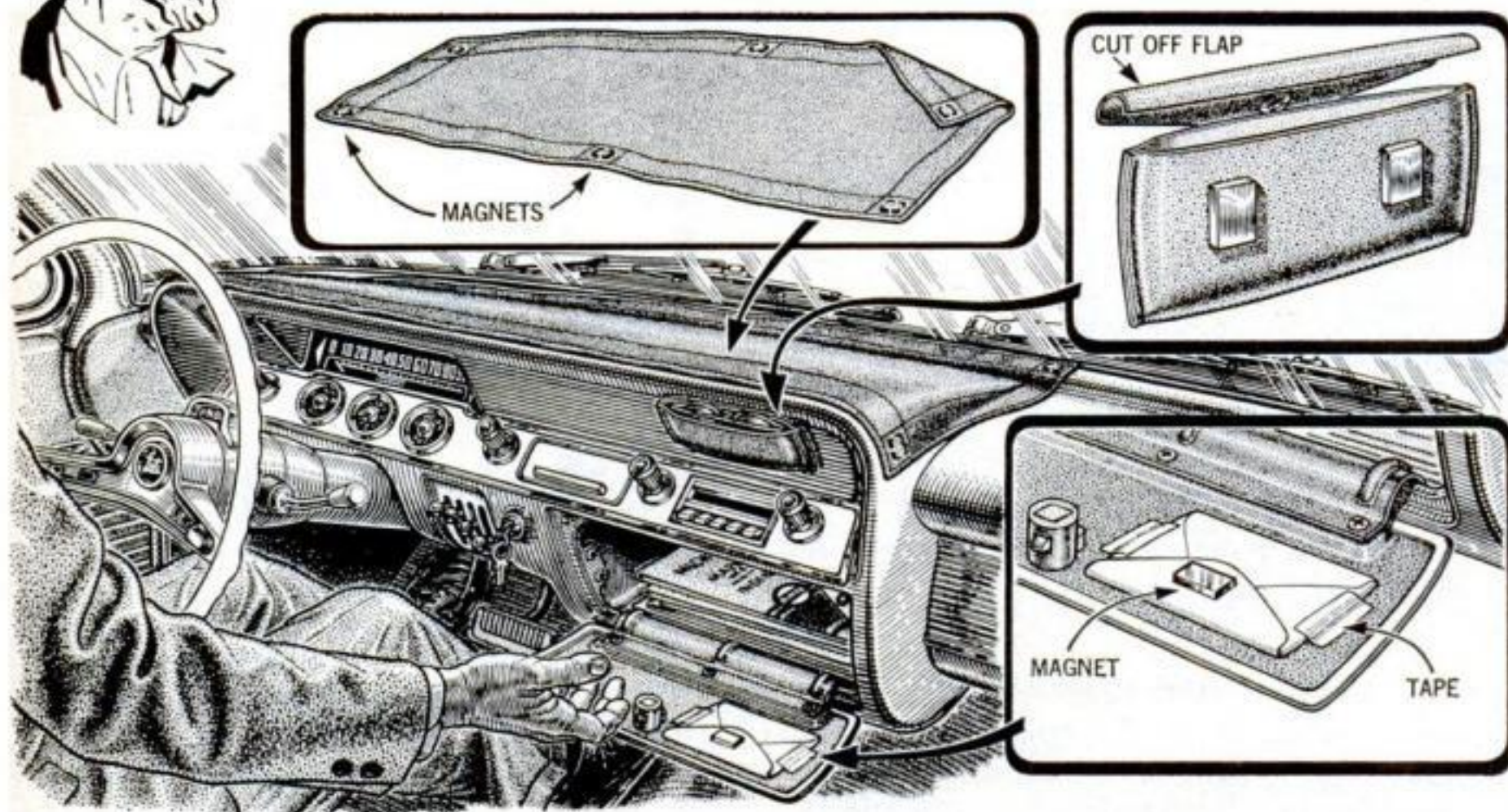
thinner made for the coating. Since pot life of the coating after it's mixed is 18 hours, don't mix more than you can use at one time. Your wall should be tacky dry in two hours, thoroughly cured in 24.

This is a tough finish when it's dry, but it needs to be babied some while you apply it. The wall must be clean and dry, bone-dry. It needn't be a new wall. But if you're

[\[Continued on page 188\]](#)

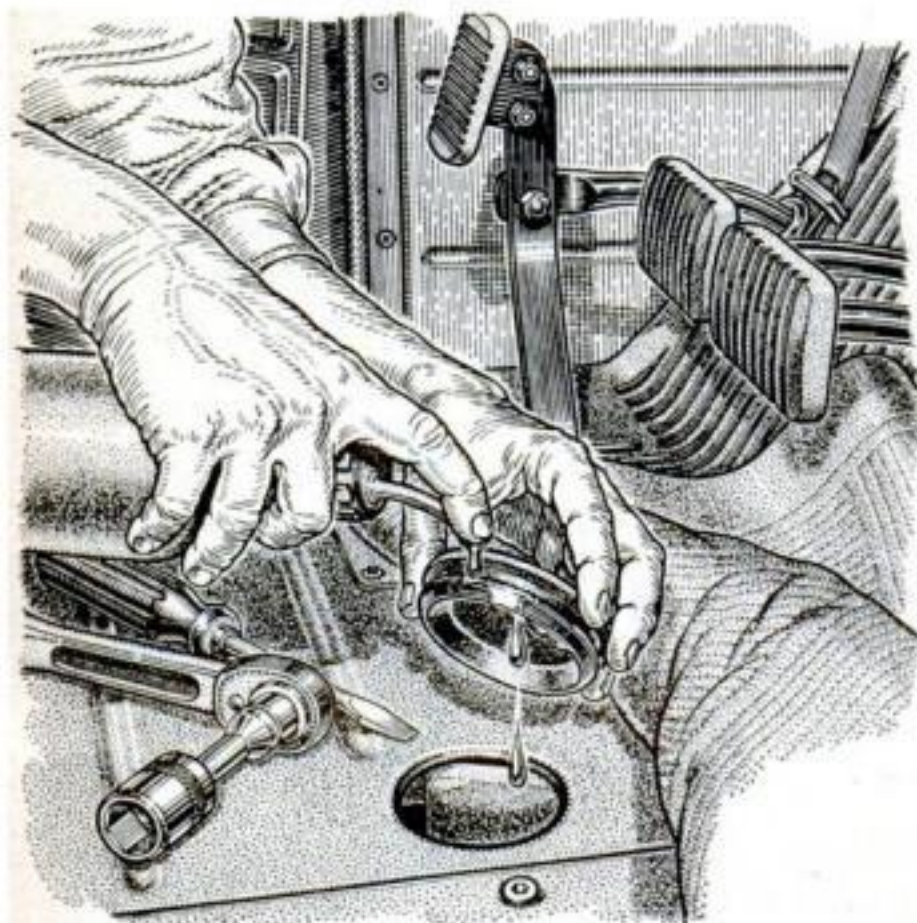


Hints from the Model Garage



Small magnets make good fasteners for many auto accessories. Sew several into the hem of a dark-colored cloth and apply it to your dashboard top to prevent glare. Or cement two magnets to the back of a sunglasses case. This keeps the glasses on the

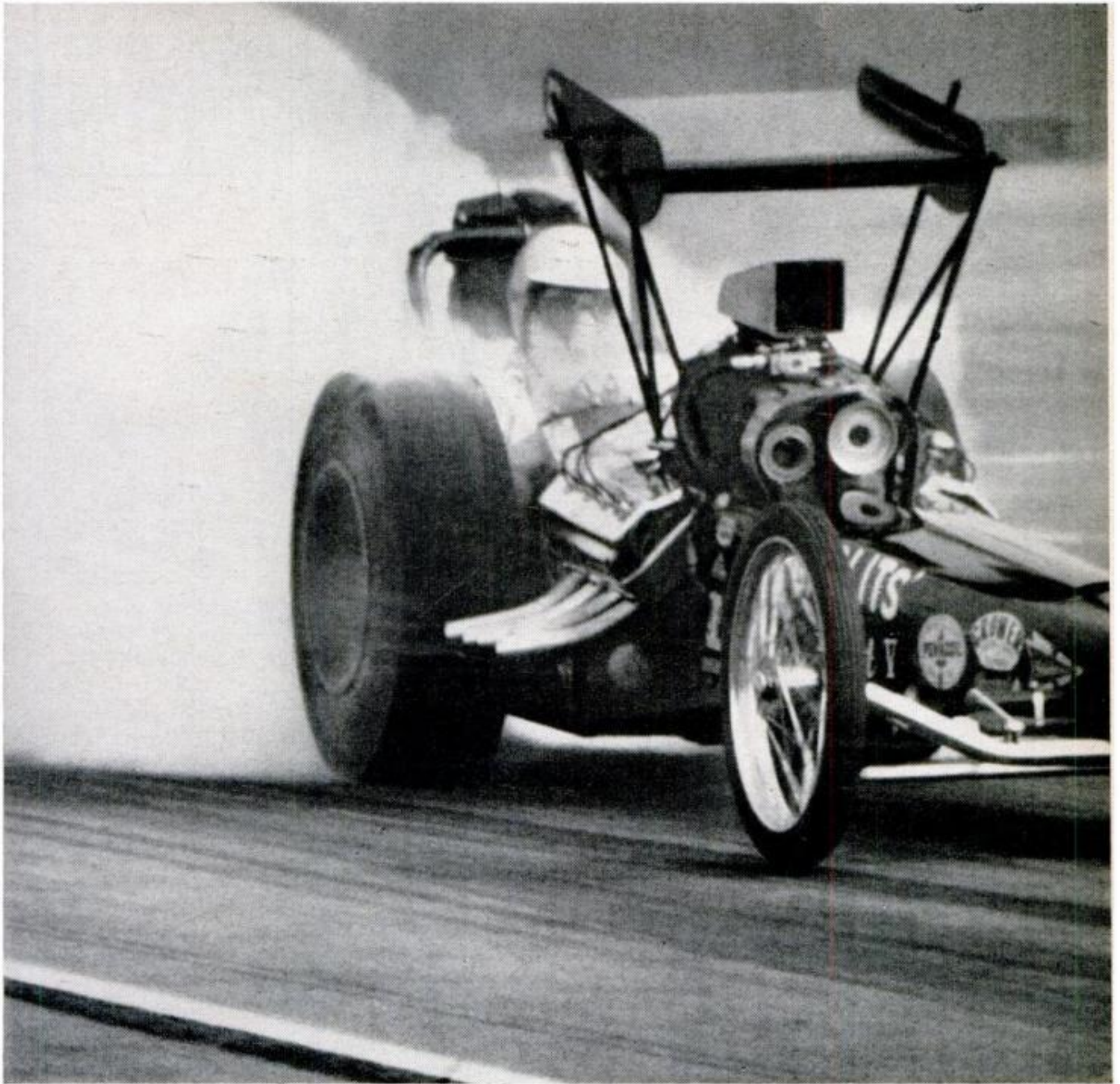
dashboard, where they're handy. Cutting off the flap makes it easier to remove the glasses. An envelope taped to the glove-box lid holds credit-card receipts and trading stamps neatly; a magnet cemented to the flap keeps the envelope closed.



To ease replacing the rubber cap over the brake-fluid-filling opening (on cars where the master cylinder is topped up through a hole in the floor), try this: Lubricate the cover with brake fluid. Floor fillers exist in many older cars and a few new ones.



A permanently mounted toolbox under the hood keeps small tools, tire gauge, spare fuses, and dipstick rag handy. Use a two-quart metal container, cutting one side away and rolling under the sharp edges. Paint it and mount with existing bolts.



Don Garlits' Dodge-powered dragster, sparked by Champions, wins Top Fuel Eliminator at the NHRA Winternationals, Pomona, California

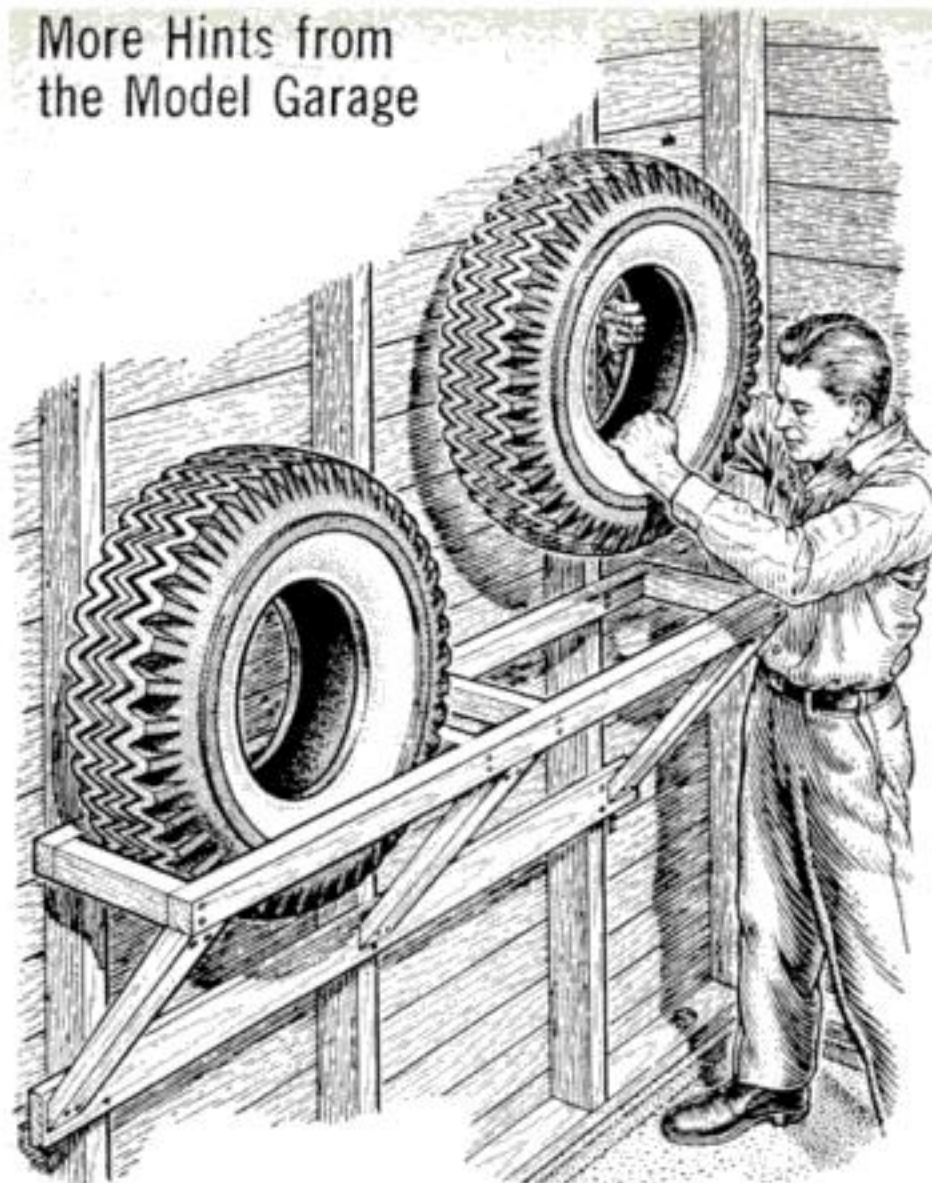
The overwhelming majority of men
who design, build or race
engines use Champion spark plugs.
Why settle for less in your car?

New Champions can give your car 26% more power...instantly!
On the average, that's what you can get with new Champions
if you haven't changed spark plugs in 10,000 miles or more!

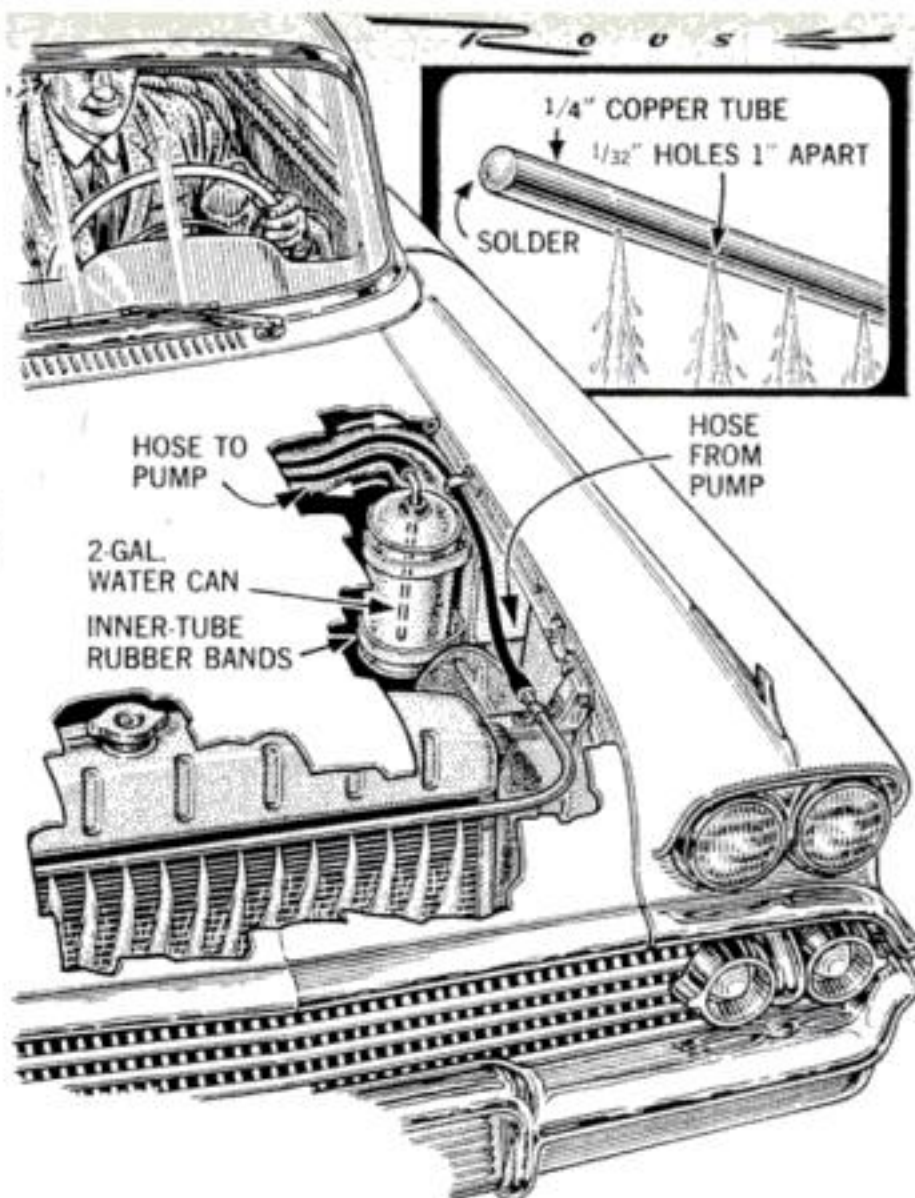


CHAMPION

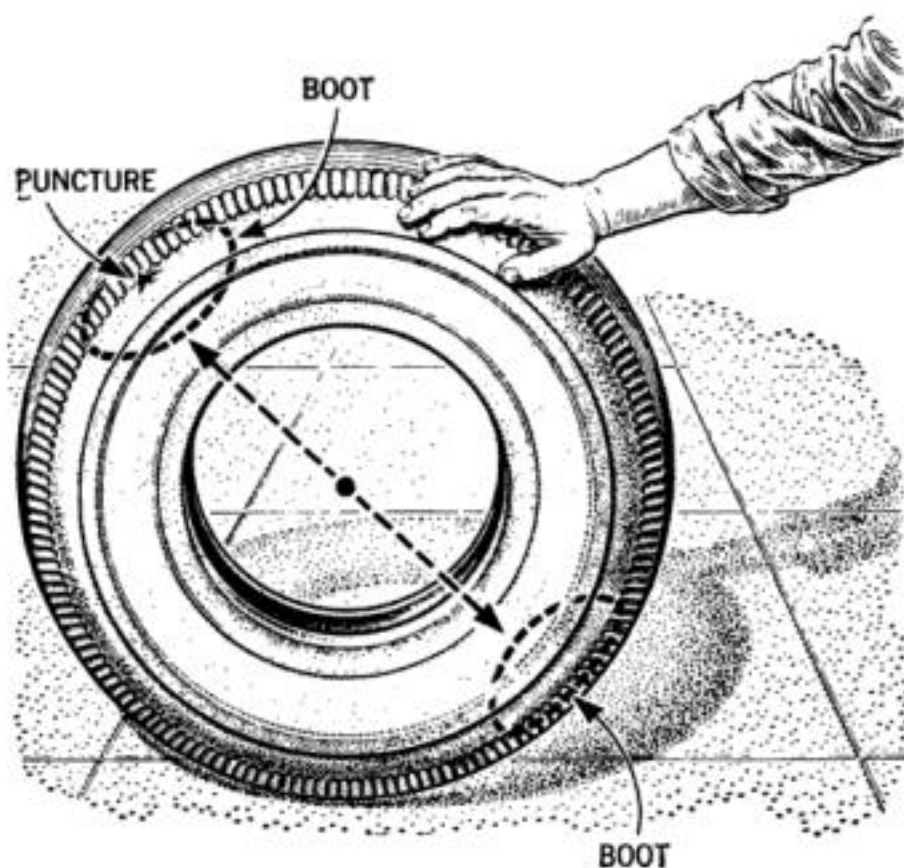
More Hints from the Model Garage



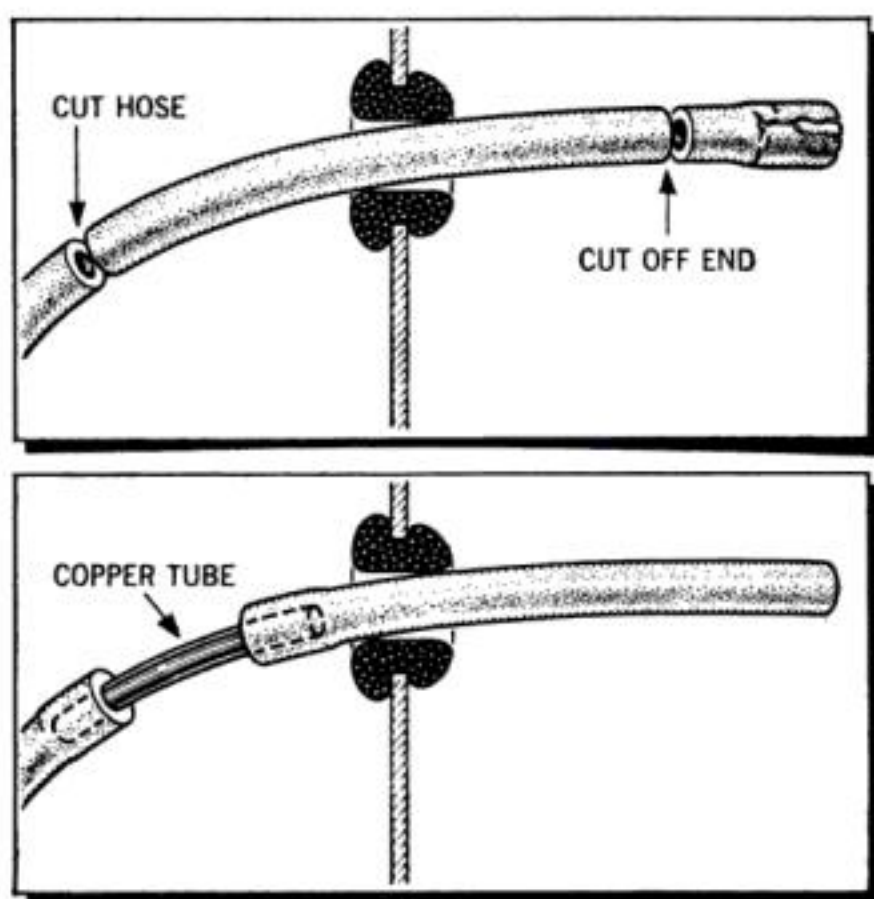
Store snow tires out of the way in a wooden rack, like the one above. Make a 60"-long frame with 9"-by-25" bays from two-by-twos and a 1" board. The storage rack serves the year round, since it holds your standard tires in the wintertime.



When towing a trailer in mountain country one reader prevented overheating by running a hose from the windshield-washer pump to a copper tube over the radiator. Water from a two-gallon can squirts from holes drilled in the tube, providing cooling.



When repairing a tire casing with a boot, install a second boot of the same size directly opposite the first. This helps balance the wheel. The cost of the extra boot is well worth while, since vibration and wheel tramp at speed are eliminated.



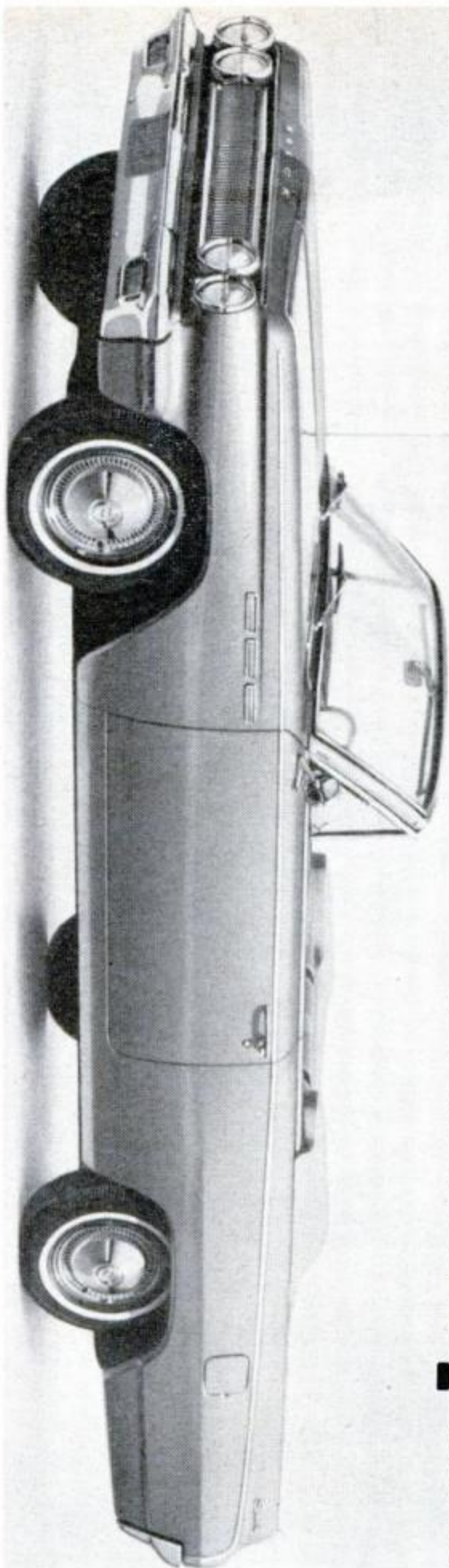
A cracked end on a vacuum hose doesn't necessarily mean replacement of the entire hose. Cut the hose in half under the hood and insert a piece of copper tubing for added length. Snip off the worn end and replace the hose on the fitting.

middleweight champion of the world

—or, the prize-

winning Buick Special is better than ever in '63! One glance is almost enough proof: The trim new Special makes every other convertible look over-dressed. A few rounds about town cinches it. America's only V-6 nimbly dances through traffic, gives you big-muscled action on very little regular gas. (There's a gas-thrifty aluminum V-8 Special, too!). Power transmission is smooth and fast. 6000-mile lubed front suspension, new "Delcotron" generator, rugged aluminized muffler are all included in the happy surprise low price. And room? Enough for 6 heavyweights, with gloves on . . . Special is *happy medium-size!* Get happy . . . go Special!

'63 buick Special



The prize-winning V-6: Engine weight from 140-179 lbs. less than in-line sixes . . . this lightness means greater gas savings. Crankshaft is shorter; more rigid, yields smoother operation. 90° engine configuration means greater engine rigidity, longer engine life. *Performance:* Torque output is similar to that of a V-8. Performance characteristics markedly superior to competing in-line sixes.

Carburetion: 2-barrel carburetor works one barrel for each 3-cylinder bank. (This results in more evenly balanced fuel distribution; there is no problem of one cylinder getting a richer gasoline mixture than any other.) Suction and exhaust strokes are evenly spaced in each bank, for better breathing and excellent scavenging of exhaust gases.

ALSO NEW FROM BUICK MOTOR DIVISION: BUICK LESABRE/WILDCAT/SKYLARK/ELECTRA 225/RIVIERA





*The two brothers
walked over to the car
Gus was working on.
It carried District of
Columbia plates.*

Gus Tracks Down a Foreign Agent

By Martin Bunn

A HISS louder than its engine heralded the entrance of a 1953 Oldsmobile sedan into Gus Wilson's Model Garage. Steam was pouring from the overflow pipe. As Gus went over, the driver got out and looked ruefully at the cloud of vapor.

"Couldn't happen at a worse time," he said. "Have to be in Springfield tonight."

"When did this begin?" asked Gus.

"Just about noon," said the driver, a broad-shouldered man in a business suit. "Had to stop four times to cool it off. Boils again after 15 minutes. One gas-station mechanic found a collapsed hose, so he replaced both of them. Another put on a new pressure cap."

"I'll check the thermostat," said Gus. "If it's okay, I'll flush the system. There's a restaurant across the street if you want a bite."

"Good. I missed lunch on account of this trouble. Name's Darby, by the way."

Taking a briefcase from the car, Darby walked out. Gus used a drop light to look for leaks around the hoses, radiator core, and water pump, but found no sign of any. With a rag, he turned the radiator cap to its first detent, let the pressure subside, and then removed the cap. No water was visible.

Loosening its housing bolts, Gus found the thermostat open. But it might have opened late—at too high a temperature—and it was of the old bellows type. From the stockroom Gus got one of the new pellet type. He was retightening the bolts when a horn sounded.

In rolled a hardtop—a 1957 Mercury. The exhaust of its V-8 engine was an authoritative bark. Stan Hicks, Gus's young assistant, hurried over. There were two men in the car, talking briskly in a foreign language. Both were under 30, and had dark hair and complexions. The driver finally turned to Stan.

"Excuse us, please. We have far to go and the car does not run well, so we are a little excited. My brother thinks we waste time searching for the trouble."

"Engine sounds good. What's wrong?"

"But it *must* be the engine. At fast speed, like 60, it goes rough as if missing. But when we go slower, we find nothing

CONTINUED

is wrong. We see your sign, so we stop."

"A high-speed miss?" said Stan. "I'll check the points and spark plugs."

"But both are already new."

"The plug gaps could be too big," explained Stan.

Both men got out. The driver stared hard at Gus as Stan put the car on the lift. While Stan checked the plugs—which proved okay—the two brothers walked over to the Olds Gus was working on. It carried District of Columbia plates.

Letting the Merc down, Stan checked the ignition points. They were like new, and the gap was correct. As he was hooking up the timing light, Stan saw one of the men—the passenger—walk out and head for the restaurant across the street.

Gus drove off in the Olds. He'd filled the radiator, checked the oil level, fan belt, and radiator core. There'd been no sign of mud on the back of the core. The headlights were free of insect debris, so he was reasonably sure the front of the radiator was, too.

He'd driven only a dozen blocks when the water temperature began to rise—and failed to level off. Gus headed back to the shop; when he drove in, the water was near boiling. The Mercury's dark-eyed driver watched his return with somber interest.

"Say, Gus," called Stan from the stockroom, "will you look at this timing light? I'm not sure it works."

Mystified, Gus entered the partitioned enclosure. Stan shut the door.

"Gus," he whispered, "those two are up to something funny. That one—the driver—hasn't taken his eyes off the Olds you're working on. And that's not all."

"It's not even much," replied Gus.

"Yeah? They say their engine runs rough—but only around 60. I can't test-drive it that fast near here. So it's only

their word. Plugs, points, condenser, and timing are all okay. When I wanted to check valve settings, he said that's been done. Fuel pump, ditto. Everything checks fine—"

"What are you getting at, Stan?"

"Gus, there's nothing wrong with that car. They're talking Spanish—and have Florida plates. The fellow who came in just ahead of them has Washington plates. I think he's a government man and these two are tailing him. One went right into the restaurant after him. Those two could be foreign agents."

"My customer's driving a pretty old car for a government man," said Gus.

"Maybe so he won't be noticed. I think we ought to get him back on the road ahead of these other fellows."

"I'm trying," grunted Gus. "Trouble is, something is wrong with his bus."

"Okay," muttered Stan darkly. "But remember I warned you."

Gus returned to the Olds. Considering its age and the heavy scale it might have in its cooling system, he decided chemical flushing was in order. Adding compound and enough water to bring up the level, he drove the car outdoors to let it idle.

A throaty rumble was coming from the exhaust of the Mercury when Gus joined Stan. But as he walked behind the car, he noticed that the hot-rod effect came from the right tailpipe of the dual exhaust.

Stan shut off the engine and turned to Gus. "I rechecked timing and point setting. All okay. Looks like the heat-control valve was frozen once—there's a stain like penetrating oil around it. But it works now."

Gus nodded. "Raise the car, Stan."

Under the car, Gus found the twin mufflers and resonators apparently sound. He tapped each muffler with a wrench. The two blows differed in sound.

Where'd it come from?



"By hook or by crook"

Peasants of feudal times were not permitted to cut down trees in the forests for firewood. However, they could gather those branches that hung low enough to be pulled down or lopped off "by hook or by crook"—the pruning hook or the shepherd's crook of the time.

A vintage car, likely a Chevrolet, is shown driving on a winding road that curves through a hilly, brush-covered landscape. The car is positioned in the lower right of the frame, moving towards the viewer. A large yellow circle is superimposed over the upper left portion of the image, containing the text "Best performance under the sun...".

**Best
performance
under the
sun...**

...comes from ACs under the hood

A tune-up and new AC Fire-Ring Spark Plugs will help your car deliver top performance during the hot weather months ahead. One big reason is AC's self-cleaning Hot Tip design. It heats faster to burn away fouling deposits . . . cools faster to help prevent preignition. AC's self-cleaning action can help improve engine power and economy mile after mile. Get your car tuned now with a new set of AC Fire-Ring Spark Plugs for the best performance under the sun.



**FIRE-RING
SPARK PLUGS**

AC SPARK PLUG  THE ELECTRONICS DIVISION OF GENERAL MOTORS

Gus came out. "I think a bad muffler is causing your trouble," he told the driver.

"But there are no holes," the man protested.

"Holes aren't all that can go wrong with a muffler. One muffler is roughing up your engine, and I think I can prove it."

The dark-eyed young man shrugged. "We have tried all else. Okay."

"Change the right-hand one," Gus told Stan. Stan responded with a sly wink.

Gus went back to the Olds, drained the chemical, flushed the system, and refilled it. When he gunned the engine, ripples and suction could be seen in the radiator neck, indicating normal pump action. He got in the car and headed for a hilly region.

Surprisingly, the water temperature climbed as rapidly as before. When Gus drove back into the shop, it was again near the boiling point. Darby, who was waiting, looked glumly at the wisps of steam emerging beneath the radiator.

"Sure wish I'd flown home."

"You don't live in Washington?"

"Only go there on sales trips. I'm bringing this heap back for a neighbor."

Gus had removed a small inspection plate in the radiator shield, through which the drain petcock was reached. Now he put in a hand to feel the radiator core, searching for cool areas that would indicate local clogging. He felt no difference until his hand met something soft and fuzzy.

Taking a light, he slid under the grille and peered up at the radiator core. He exhaled slowly, whistling softly. What he saw was a mass of feathers—four dead birds, wings outspread as if in flight. They covered more than half of the core's cooling area. Pulling them free, Gus dropped the birds on the floor.

"Now I remember!" Darby burst out. "Coming around a bend fast, I ran smack into a flock of birds. They flew up—I thought they'd all got away."

"These didn't make it. The grille openings are so big they went clean through till they hit the core. Sorry I didn't spot them sooner."

"I should have tipped you off," returned Darby, getting out his wallet. "You found the trouble the hard way."

Stan was killing time mounting the new muffler. Gus removed the discarded one to a workbench, called the driver over, and

proceeded to hacksaw the casing apart. When opened, the two parts proved to be solidly packed with a brownish-black mass, except for a small center passageway.

"There's what was fighting your engine," said Gus. "This sludge, what's left of corroded baffles and wire mesh, choked the exhaust from the right cylinder bank. At high speed, back pressure got bad enough to kill power on that side. The clogged baffles also made the muffler noisy."

His audience now enlarged by Stan and the other stranger, Gus went on. "Why did this one load up? Because with dual pipes the heat-control valve channels exhaust from the right bank through the intake-manifold crossover for carburetor warmup, then out the *left* muffler. That muffler gets hot fast, burning out the water, oil, and raw gas in the exhaust. Some exhaust gets to the right-hand muffler, too—the valve doesn't cut it out altogether. But this muffler doesn't heat up, so sludge, acid, and carbon form in it.

"Once the engine's warm, the valve is supposed to open. Apparently yours was frozen shut once, letting this muffler run cold a long time—and sludge up—until somebody spotted the sticking valve and freed it. You'll see the difference now."

"That will please my brother," said the driver. "He is just coming from Puerto Rico and is anxious to drive on to see his girl here. I myself came years ago as a chauffeur to drive such a car as the one that just left."

"No wonder you were interested in it," said Gus, with a glance at Stan.

"Yes. The owner brought me here, so that kind of car I always remember."

"Your own will be ready in a jiffy now," promised Gus. "Won't it, Stan?"

Red-faced, Stan nodded and fled to finish the job.

"*Too many spy thrillers on TV*—that's my trouble," grumbled Stan when he and Gus were alone. "Those two Latin types turn out to be innocent American citizens, and the mystery man's a traveling salesman."

"You weren't all wrong. After all, we did find foreign agents, didn't we?"

Stan snorted.

"What else would you call sludge like that, and four dead birds?" asked Gus. "Besides, like the foreign agents you meant, they made a lot of trouble as long as they weren't suspected." ■ ■

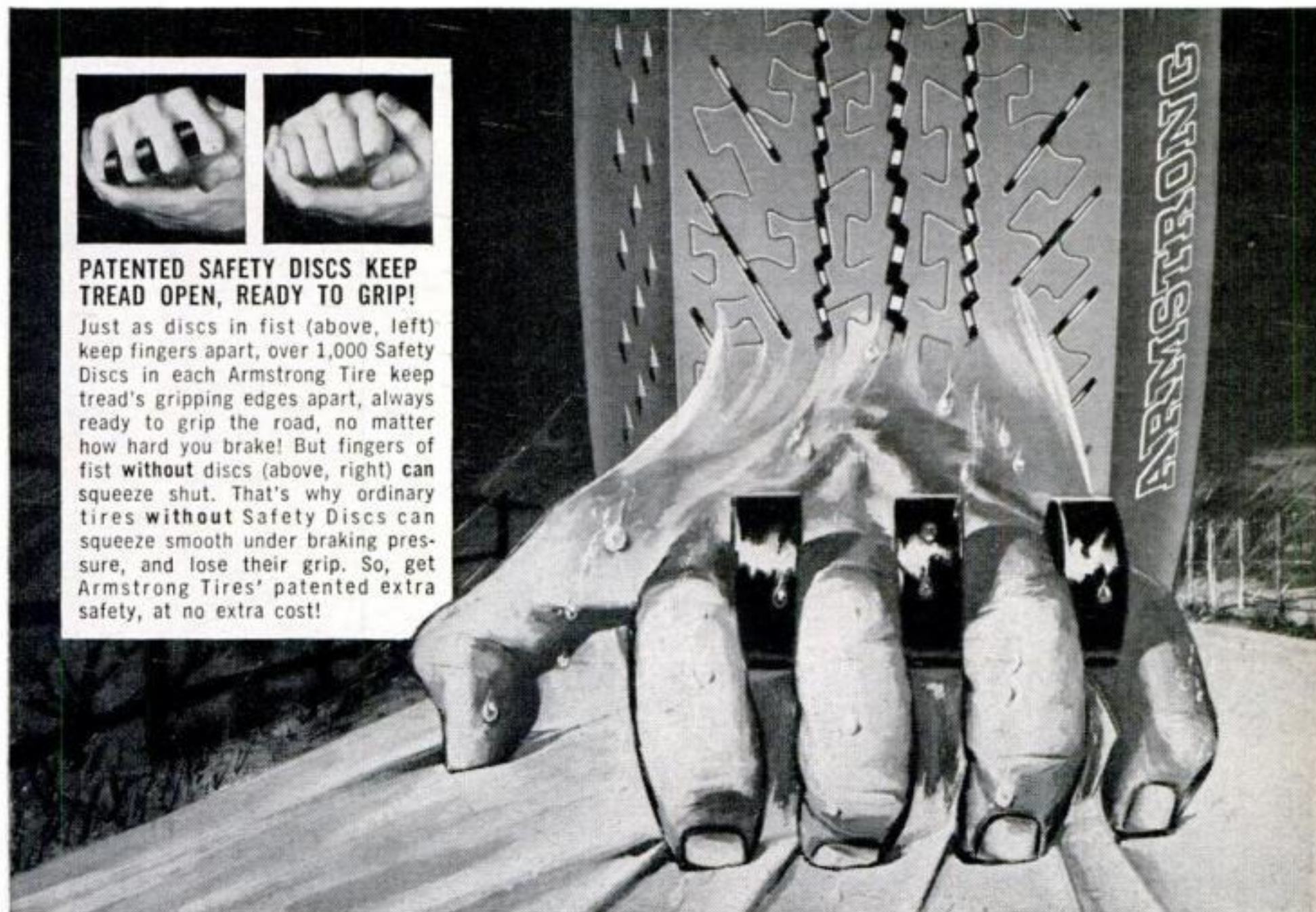
ONLY ARMSTRONG TIRES CAN SAVE YOUR LIFE

with "Ounce of Prevention" Safety Discs!



PATENTED SAFETY DISCS KEEP TREAD OPEN, READY TO GRIP!

Just as discs in fist (above, left) keep fingers apart, over 1,000 Safety Discs in each Armstrong Tire keep tread's gripping edges apart, always ready to grip the road, no matter how hard you brake! But fingers of fist **without** discs (above, right) can squeeze shut. That's why ordinary tires **without** Safety Discs can squeeze smooth under braking pressure, and lose their grip. So, get Armstrong Tires' patented extra safety, at no extra cost!



Armstrong's Exclusive Wide-Track tread design doubles the width of the outer ribs — doubles the rubber where tires wear most!

PLUS! up to 10,000 MORE SAFE MILES with WIDE-TRACK TREAD DESIGN!

Which part of a tire wears out first? Take a look at your own tires. You'll find the *outer tread ribs* take most of the punishment. That's why ordinary tires, with narrow outer ribs, so often disappoint you on mileage. To prevent this mileage loss, Armstrong engineers developed the Wide-Track Tread.

This exclusive design doubles the width of the outer ribs — doubles the rubber where tires wear most — to give you up to 10,000 more safe miles than ordinary tires. Get Armstrong's Wide-Track tread design, and get extra mileage at no extra cost! See the Yellow Pages for your Armstrong dealer.

The Armstrong Rubber Company, West Haven, Conn.
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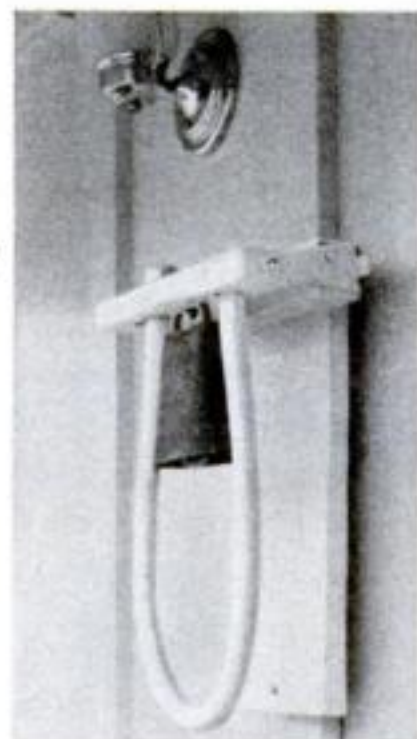
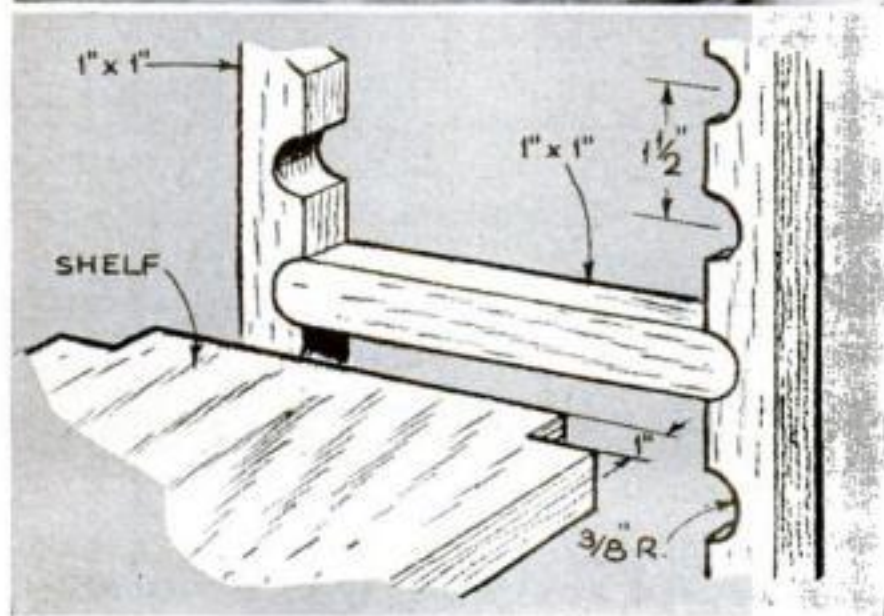
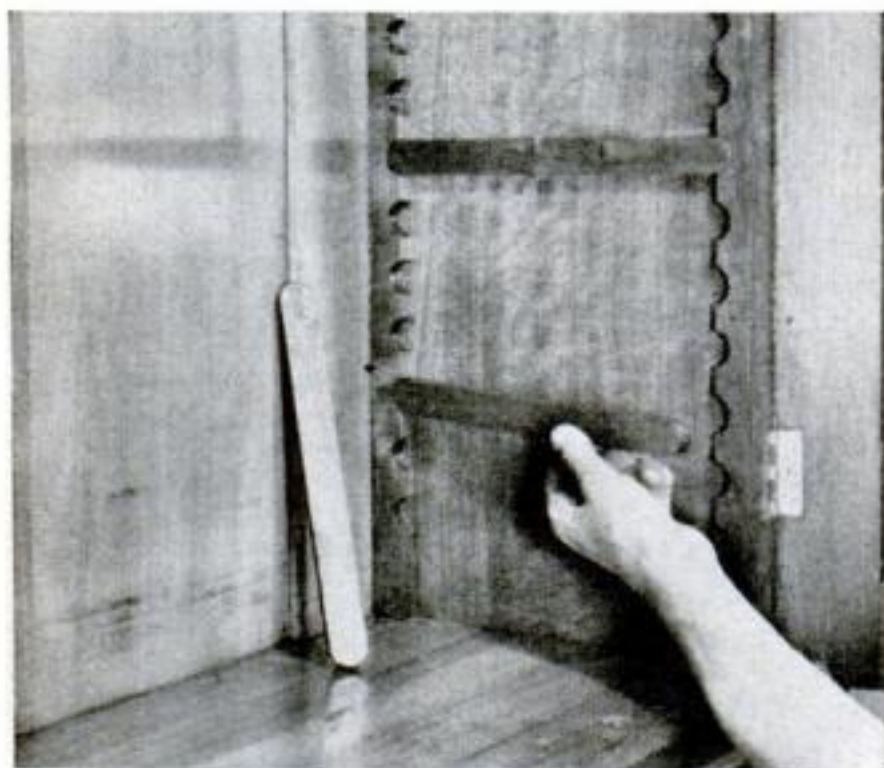
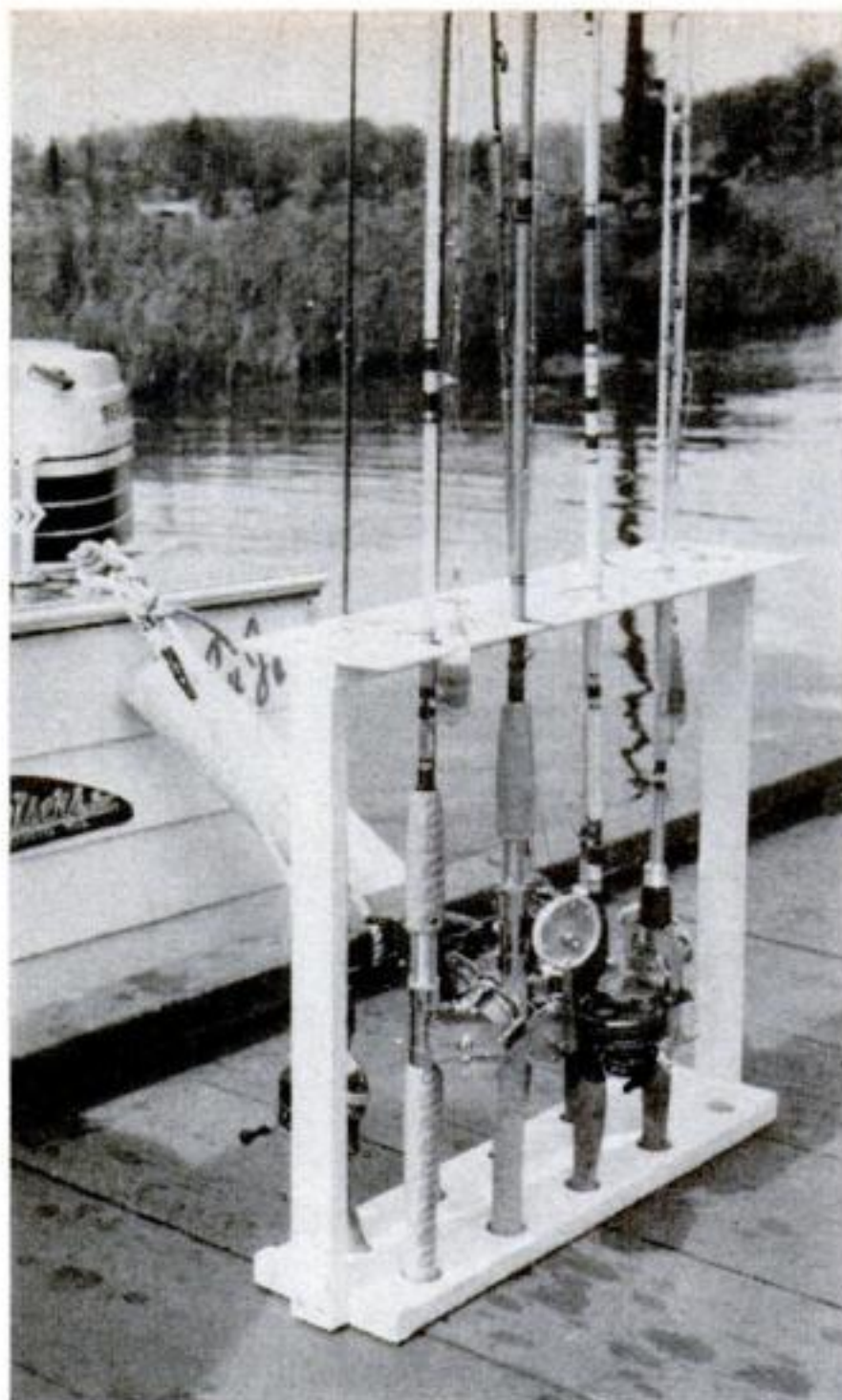
You can't buy a better tire . . . to save your life . . . than Armstrong!

Portable rod rack for boaters

This handy fishing-rod rack holds up to 10 poles, keeps them upright and out of the way on either boat or dock, and can be transferred easily between the two. I used scrap lumber for mine, drilling holes through the bottom piece for the rods. A sheet of plywood nailed to the underside keeps them from slipping through. Slots sawed in the upper cross board permit the rods to be slipped in or out, while rubber bands, fastened to hooks in the wood, hold them in place.—*J. R. Whiteside, Glen Ellyn, Ill.*

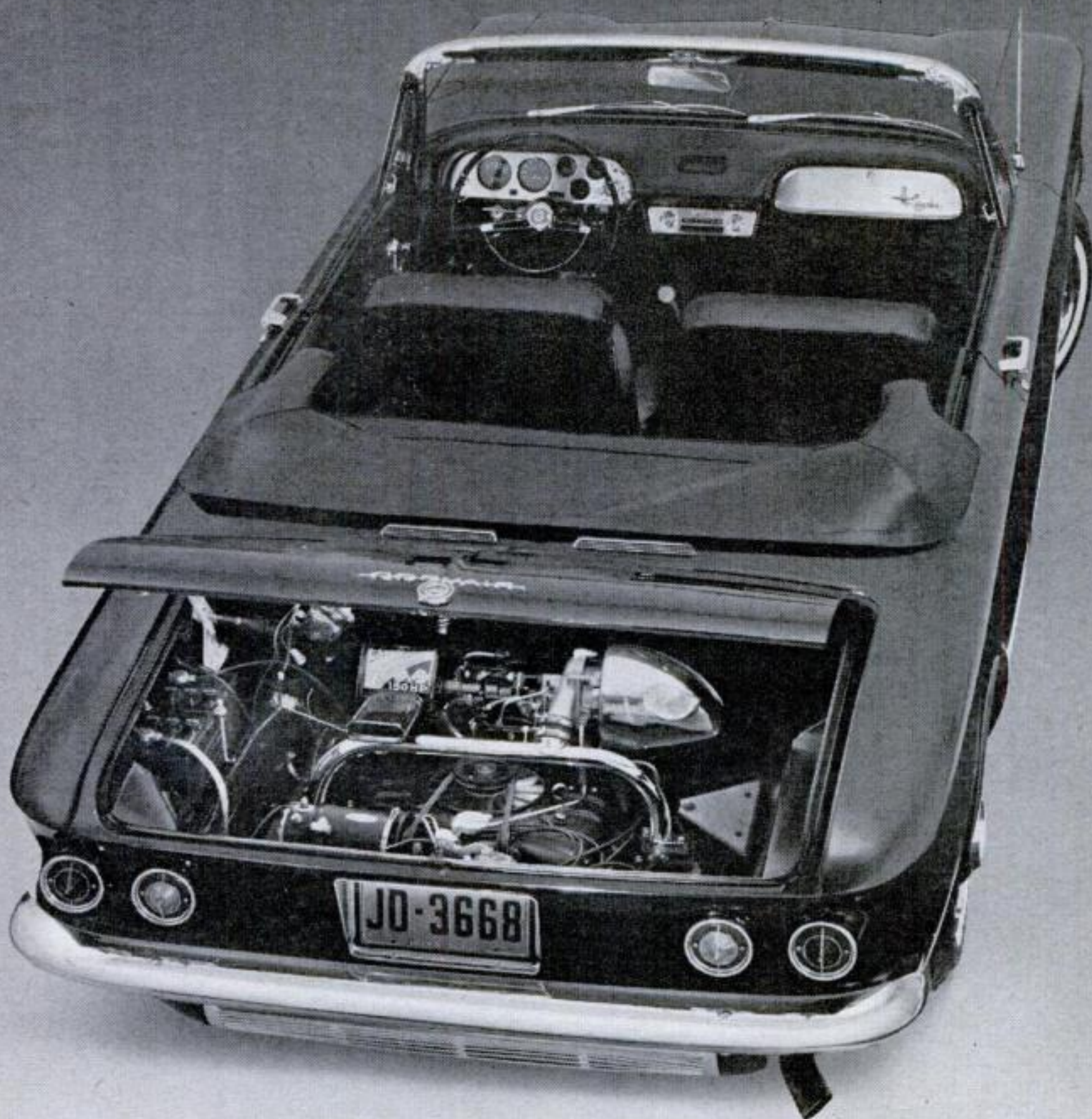
Adjustable supports for shelves

Need some adjustable shelves? Here's a trick usually overlooked by cabinetmakers. Cut rounded notches in vertical pieces; insert a crosspiece between corresponding notches; and let the shelf ends rest on the crosspieces. To make the notches, clamp two strips edge to edge and drill $\frac{3}{4}$ "-dia. holes— $1\frac{1}{2}$ " or 2" apart—on the line between strips. Round the crosspiece ends to match the notches.—*W. E. Burton, Akron, Ohio.*



Oxbow doorbell is easy to make

For a doorbell with an Old West touch, try this one. Steam or soak a piece of $\frac{3}{4}$ " hickory or spruce. Bend it into the shape of an oxbow and keep it in this form until dry. Mount a two-by-two crosspiece on a scrap of 1" stock. Fasten the bow and a cowbell to a piece of one-by-two. Using a strap hinge, attach the bell section to the mounted crosspiece. The assembly pivots on the screws.—*Hi Sibley, Nuevo, Calif.*



IS the Spyder's thrust just so much hot air?

A rhetorical question if ever we posed one. Sure, the Corvair Monza Spyder* uses hot exhaust gas to power its turbo-supercharger. Gets 150 hp as a direct result. But hot air alone does not a Spyder make. This is no bolt-on firecracker with a short, loud life-span. We beefed up that 145-cubic-inch air-cooled Corvair power plant to take the extra stress in its stride. Added super-alloy exhaust valves. Redesigned the exhaust valve guides for excep-

tional heat dissipation. And put in a more rugged crankshaft. Then added heavy-duty connecting rods and chrome-plated upper piston rings. Result: performance every bit as reliable as it is potent—and that's plenty. There's something very solid about the Monza Spyder—and that isn't hot air....Chevrolet Division of General Motors, Detroit 2, Mich.

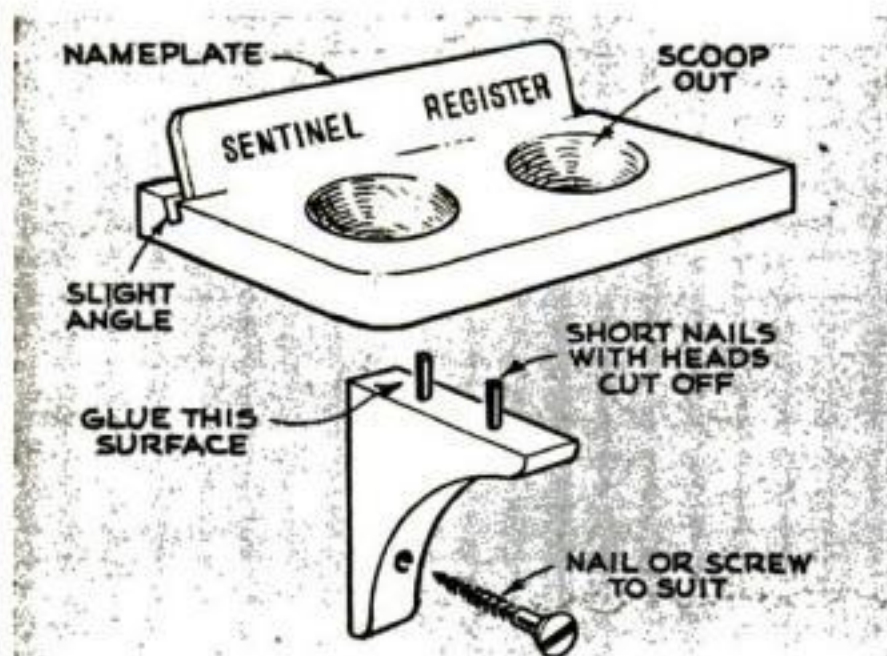
CORVAIR SPYDER

CHEVROLET

*Spyder equipment and radio as shown optional at extra cost.

Short Cuts and Tips

FROM
PS
READERS



Change holder to pay newsboys

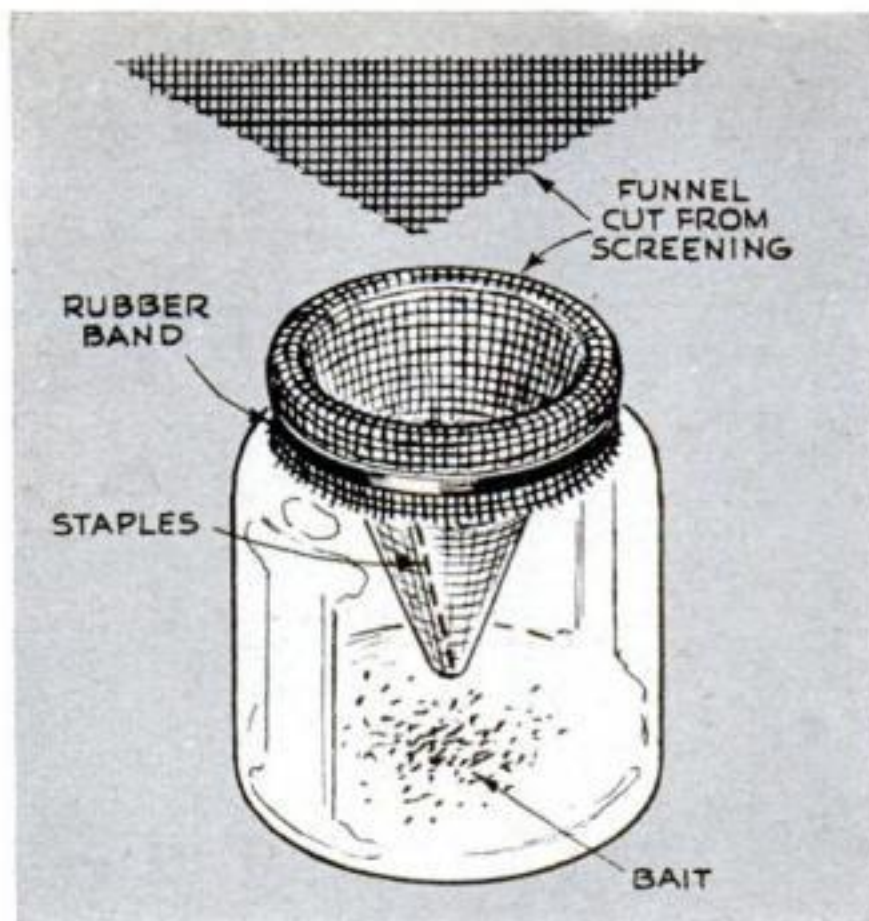
We have Sunday and weekday editions of different newspapers delivered by different newsboys. When a boy comes to collect, it has always been necessary in the past to ask him to wait while we searched for change. And the boys have sometimes been paid twice when one member of the family didn't know that another one had already paid. To avoid delay and keep an automatic check on payments, I devised the change holder shown above and mounted it near the door.—*John Zelem, Ansonia, Conn.*

▶▶▶Next time you want to cut a piece of metal window screening—circular, triangular, square, or irregular—first apply masking tape to the lines where you'll make the cut. Then cut through tape and wire with tin snips and the dimensions will hold perfectly.—*L. C. Juchau, Napa, Calif.*



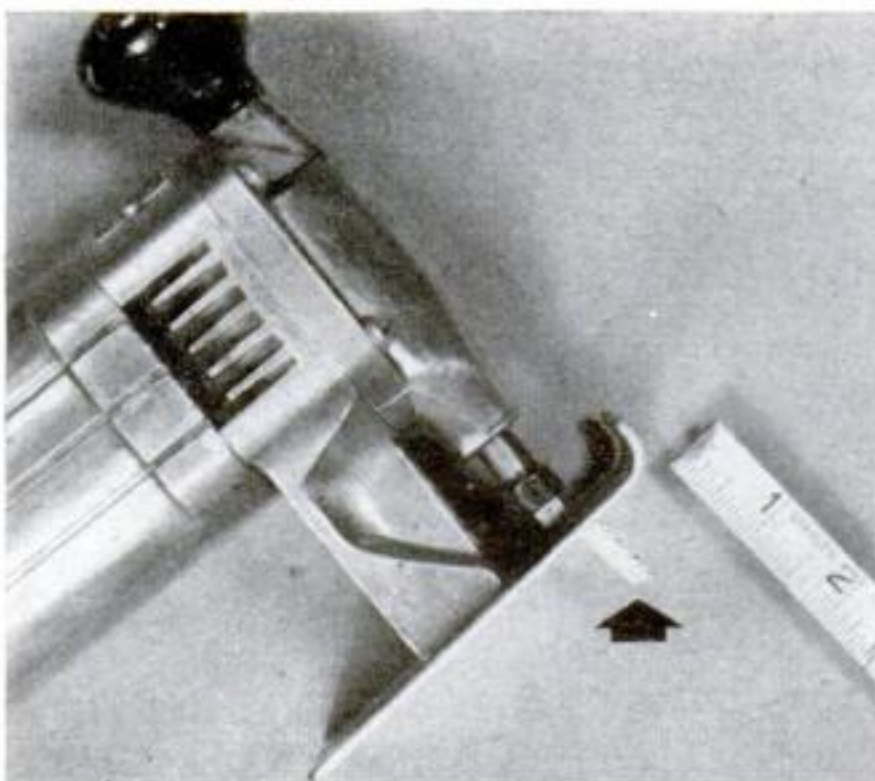
One way to "stretch" a bolt

It was late at night and I couldn't go to the hardware store for an extra-long bolt I needed. So I made one. I cut the head off a short one, looped it around the threaded end of another, compressed the loops in a vise.—*R. J. Phillips, Uncasville, Conn.*



Easily made trap controls roaches

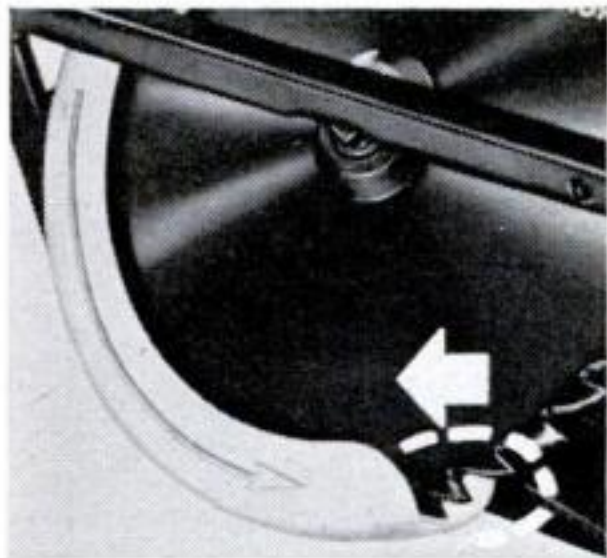
For a long time, I've been using insecticides to control roaches in the basement of my home. The fumes always irritated my wife and our pets, and we never got rid of the bugs. Now, I've licked the problem with the trap shown above. The hole at the tip of the cone is just large enough for an insect to go through. When one does, lured by the sugar I use as bait, it can't get out again. After a few days, I pour water in the jar and flush the roaches down the toilet.—*Richard A. Burke, NYC.*



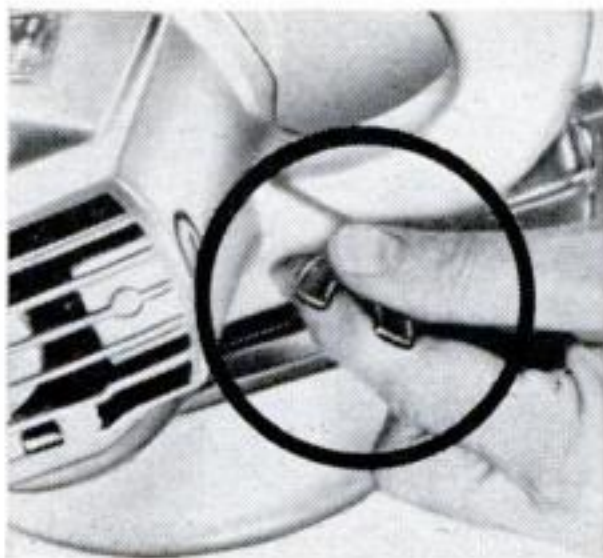
Controlling depth of a saw cut

To make sure he didn't accidentally saw into wiring in cutting out a section of plaster wall, one home owner ground down his saber-saw blade so it projected $\frac{3}{4}$ " as shown above—just equal to the thickness of the material that had to be cut out.

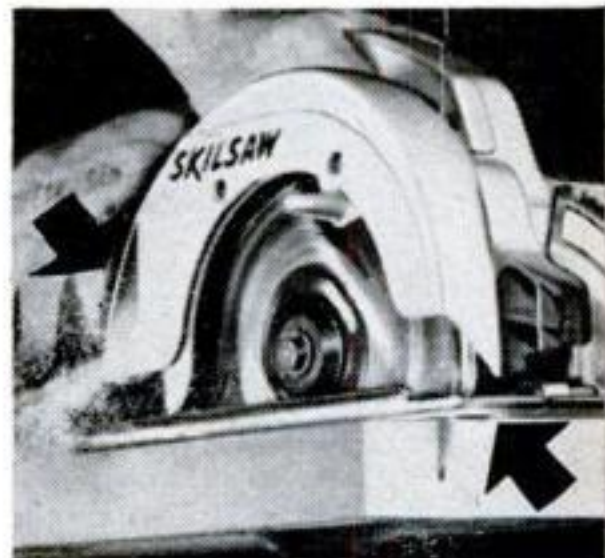
6 REASONS WHY SKILSAW POWER SAWS OUTSELL EVERY OTHER MAKE!



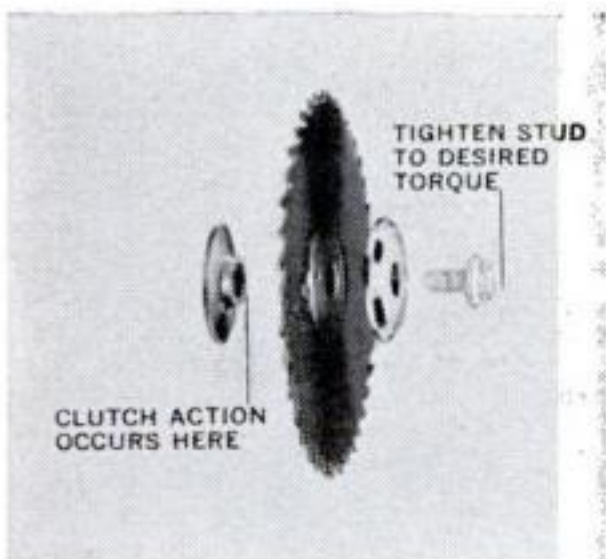
Bind-free lower guard—Retracts automatically when saw base is tilted, thus allowing bind-free starts—even on compound miter cuts.



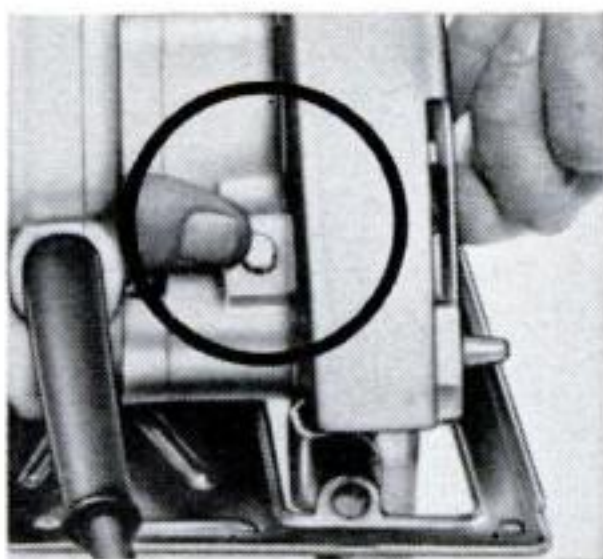
Easy-to-set depth control—Conveniently located for easy one hand adjustment. Control locks the saw firmly and quickly at any desired cutting depth.



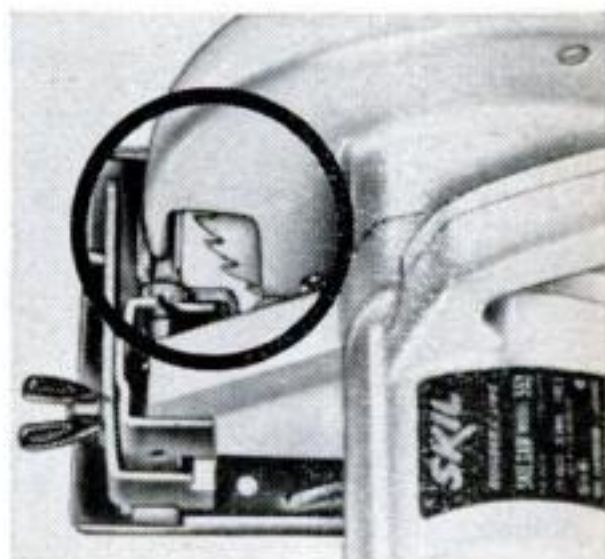
Exclusive sawdust ejection—Special air stream ejection system directs sawdust down to floor, away from the operator; blows it off the line of cut.



Vari-Torque safety clutch—Disengages blade if it binds or jams. Protects gears and other parts from damage, prevents saw kick-back.



Exclusive Blade Lock* (Patented Feature) For fast, easy blade changes. Push-button engages and locks blade shaft for greater user safety.



Full-View Blade—Upper blade guard designed to allow clear view of blade all through the cut for absolute precision and accuracy.



Skilsaw Model 536—World's largest-selling 6½" saw. Makes 45° bevels in 2" lumber, has super burnout protected motor. Other models up to 8¼".

There are many more features, too! Like super burnout protected motors on *all* models, and full ball-bearing construction on heavy-duty models.

Because Skil never compromises on quality, no other saw offers all these features to make every cutting job easier and faster.

Skilsaw Power Saws are made in both deluxe and heavy-duty models with full range of blade sizes from 5½" to 8¼". See them at your nearby lumber and hardware store. Prices start under \$30—slightly higher in Canada.

SKIL
POWER TOOLS

* available on heavy-duty models only



New Merc 110/9.8 hp/2 cylinders

MerCs never get steamed up over a few weeds

When you head into the rough stuff after the big ones, you don't have to worry about your Merc coming to a steaming stop. A Merc doesn't have a protruding nose on the lower unit to hang up weeds, clog the water pump, and cause overheating.

Glide-Angle design lets a Merc slide through weeds, over logs and shallows so easily and quietly that the big sleepers won't hardly know you're there.

Besides that, Merc's one-piece lower unit will take hard knocks that would bust the seams on other outboards.

And you don't shear pins, because it has none. Instead, Merc has a live-rubber clutch that momentarily gives with the impact.

Over open water or through weeds and reeds, Mercury gives you more RUN for your money.

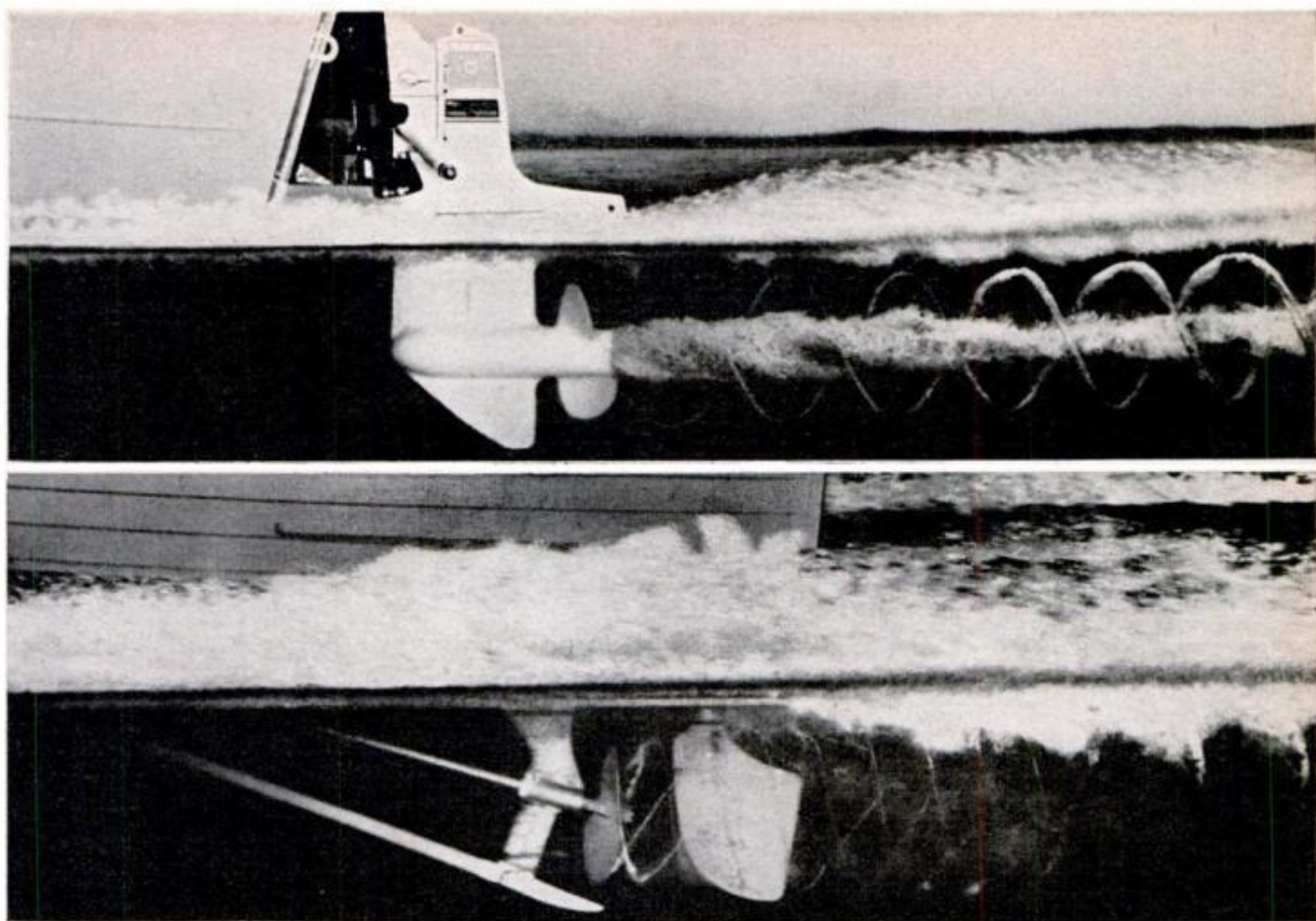
MERCURY

100, 85, 65, 50, 35, 20, 9.8 and 6 hp outboards



MerCruiser Stern Drive
Power Packages • 310, 225,
190, 140, and 110 hp gasoline
100 and 39 hp diesel

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and Toronto. Subsidiary of Brunswick Corporation



Photographed underwater at Florida's Silver Springs

Ordinary inboards are not on the level

MerCruiser Stern Drives push your boat more efficiently because the propeller thrust is directly parallel to the plane of motion.

There is no drag from a rotating shaft, fixed strut, or rudder

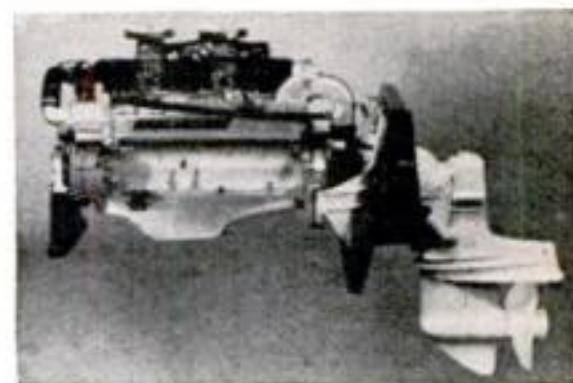
The propeller shaft on an ordinary inboard is mounted at a steep angle through a hole in the bottom of the boat and wastes much of its forward thrust by pushing downward. MerCruiser Stern Drives, mounted through the transom, apply all of their power in a true plane with the direction of motion. *Ordinary* inboards, converted for test purposes to MerCruiser Stern Drives, show a 10 to 25% increase in speed with the same power plant.

MerCruiser Stern Drive Power Packages top even this efficiency by matching the MerCruiser Stern Drive to the proper power plant. Boats powered by MerCruiser give you automotive-like silence, sound 4-cycle engine economy and the prestige of an inboard. They give you the convenience, the maneuverability, the impact protection of an outboard. MerCruisers have no rigid struts, fixed propeller shafts or rudders to damage. Their drive and engine mounts are rubber-cushioned, the propellers shear-proof. MerCruiser's tilt-up feature lets it go any place an outboard can go.

More than 110 different boat manufacturers are building boats powered by MerCruiser Stern

Drive Power Packages . . . giving you a far wider boat and power choice than ordinary inboards. Ask your MerCruiser dealer to show you the boats *you* can own . . . equipped with MerCruiser Stern Drive Power.

MerCruiser 140:
140 hp, 6-cylinder,
in-line engine and
MerCruiser I Stern
Drive. All controls
and cables are inside
the boat. Water-
cooled gear cases.
Jet-prop exhaust.



MERCUISER

110, 140, 190, 225, and 310 hp gasoline
39 and 100 hp diesel

**STERN
DRIVE
POWER
PACKAGES**

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leap, and catch the ball in mid-air 30 feet or more away.

Such tracking skill means that the eye not only accommodates to the variation in intensity of light in air and water, but also to the way light bends as it passes from one medium to the other. This is another puzzlement for scientists.

The big question: Given all this fine engineering equipment, does the animal lead an automated existence triggered by instinct only? Or does it direct its behavior in a thoughtful, maybe man-equivalent way, as Dr. Lilly suggests?

I asked a number of scientists, including a group of biologists at the Lerner Marine Laboratory, a field station of the American Museum of Natural History on Bimini in the Bahamas. One of that group is a distinguished authority on porpoise behavior, Dr. Margaret Tavolga.

Neither she nor her Bimini colleagues agree with Lilly. "If forced to make a comparison, I'd say that a porpoise is somewhere between a dog and a chimpanzee in intelligence—maybe on a level with the chimp," Dr. Tavolga says. "The real difficulty lies in deciding what you mean by animal intelligence—and finding a foolproof way to test it. Until that time, you'll have to take a lot of porpoise stories with a grain of salt."

"You mean like porpoises being friendly?" I asked Dr. Tavolga. "What about the stories of porpoises saving swimmers' lives by pushing them to shore?"

"Porpoises are curious animals," she said. "They'll play with lots of objects. But there's no reason to suppose they'd deliberately push the objects toward shore. They might equally well push them to sea. But you never hear those statistics."

On the other hand, neither Dr. Tavolga nor any other porpoise specialist would deny that, in general, porpoises appear to be playful animals, and that playfulness is probably a sign of intelligence.

Infant porpoises in captivity, for example, seem to go through chasing and teasing stages. As they grow older they often team up in games like "Catch the Pelican Feather" or "Tease the Turtle."

Sometimes porpoises extend their playfulness to human partners. According to Forrest G. Wood Jr., curator at Marineland of Florida, you might say that porpoises

have learned that human beings can be taught tricks. "Porpoises have found that if they toss a rubber ring to someone standing at the rail, that person will quickly learn to throw it back."

A porpoise with a purpose? From such activities to problem-solving or purposeful behavior is a big leap. Again, the observations are interesting:

There is the story of the two porpoises at California's Marineland, for example. They were trying to tease a Moray eel that had slithered under a rock. One porpoise went off and killed a scorpion fish. The other remained—presumably standing guard. When the first porpoise returned, it pricked the eel's skin with the poisonous spines of the fish and drove the eel out.

Such behavior, whether deliberate or accidental, suggests that the porpoise has a complex brain. Dissection confirms this. What is particularly interesting is the large amount of cerebrum—the "higher" part of the brain. It is this anatomical feature more than any other that prompts Dr. Lilly's speculations. He has buried tiny electrode probes in a live porpoise's brain and observed what happened as they were moved about. He discovered that when the probes hit one of the "pleasure centers" the porpoise could be trained to close an electrical circuit with its jaw to receive stimulation.

"By the time I was able to hook up the switch to the rest of the apparatus," Dr. Lilly writes, "the porpoise had learned the proper way to push it and was pushing in order to start the stimulation."

Dr. Lilly believes that this kind of savvy, in combination with the porpoise's acute hearing and prima donna vocal range, make the animal a prime candidate for communications experiments.

But others argue that porpoises aren't that perceptive. The impressive stunts porpoises pull off in shows take months of conditioning, trainers say.

As for their "voices," even if the porpoise can make human-like sounds in air—which many specialists doubt—would the sounds be meaningful or simply mimicry?

Thus the debate continues, spurring research in a long-neglected field. Whether the porpoise is just another chimp or a new I.Q. champ, only time—or the porpoises themselves—may tell. And they're not talking. Yet. ■ ■



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the pump and no "wear ring" is needed to maintain nozzle pressure, silt, sand, and gravel are no problem. In fact, the pump is much simpler than conventional gearing, clutch, and propeller—and there's nothing under water to drag or get bunged up.

Also, the unit's grilled intake foot rides exactly flush with the bottom of the boat, and objects small enough to enter the screen are no problem to the pump or nozzle. The intake foot won't foul easily in weeds or debris. A paper bag or lily pad *can* cover it at slow speeds—but then the boat will stop and the obstruction is easily removed, so it's no sweat. At high speeds such items either tear off or rip into pieces.

Since the jet nozzle exhausts 5" above the boat's bottom and at, or above, its planing waterline, its thrust angle is high and nearly straight ahead instead of a bow-lifting push below the craft's bottom.

Put your hand to the tiller. It's tough to make the jet cavitate, either in white water or where a thick keel aft would cause a prop to go airborne. Steering is excellent—with no torque effect at any speed—and is done in the same way as with a propeller. Even with the throttle closed, the intake foot still acts as a shallow-draft rudder.

To lose headway, or to move the boat in reverse with full steering control, the cup-like gate is moved over the nozzle by a control rod that ties into the motor's conventional gearshift lever.

While either racing or load-type jets could be built, the present units are designed for use on the average boat and are comparable in performance to stock outboard propellers. So compared, they average 85 to 90 percent of propeller speed and power.

A thrust of 10 to 11 pounds per horsepower is claimed by the maker. In recent tests, a 14' runabout with five adults aboard—gross weight, 1,250 pounds—was planed with a jet-equipped, 25-hp. Johnson motor. It was rather sluggish getting up on plane—but was then clocked at 16 m.p.h.

The same boat with driver alone did 24 m.p.h. and cruised easily at 20 to 22. With an identical prop-equipped motor, its top speed was 28 m.p.h. Fuel economy was about the same for both motors at high speeds, but the jet job dropped off considerably at low speeds.

Getting a jet aboard. The units list at \$295 and can be installed in about an hour,

using the regular bolt and screw holes. Just follow instructions. Jets also require 20" transoms. If yours is 15" high, either buy an available clamp-on bracket (\$17) from jet-unit dealers, or build your own to the necessary height.

If the price makes you flinch, remember that never again will you find someone's fishing line or mooring line—or your own bow line—wrapped tight around the prop shaft. Nor will you need to stop every few feet to clear away weeds in water.

You can land on the beach to load passengers and back off again under power without tilting your motor. The lower unit will never run afoul an underwater obstruction. For trailering and launching there's no problem caused by a protruding lower unit.

Many jet conversions are already in use in the West and in Alaska. The company is now busy expanding into the Midwest and East. So before long, you'll be able to see and try one out for yourself. Or write the company direct if you're in a hurry. ■ ■

Let It Fall!

[Continued from page 97]

the edge of the sink. One fragment lacerates his thumb to the bone.

Some experts think that such reflex actions are basic human instinct, possibly derived from the desire of our prehistoric ancestors to save their few handmade possessions from loss. Others believe that it is not an instinct, but an acquired habit.

Early in your training you were taught the consequences of dropping something that breaks. Even though small children have poor co-ordination, as seen in the continual spilling of milk or dropping of cutlery, the adult with his stern views of the social graces expects miracles of them.

Small wonder that the child develops a reaction, whether out of fear of consequences or the desire to please, that might some day result in serious injury or death.

Now is the time to start training yourself, young or old, to *let things fall*. Fight inhibitions, instincts, and impulses. Throw up your hands when an object falls. Jump back, or away from it. A gouge in a tile floor is not as unsightly as a missing limb. A smashed jar is easier to clean up than spilled blood.—Joseph Tartas, Haskell, N. J.

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The very best to cut, drill, drive...



UTILITY KNIFE — The safest knife you can buy! Blade securely locks out for cutting and scoring, retracts in handle and locks when not in use. Safe to work with; safe to carry in pocket.

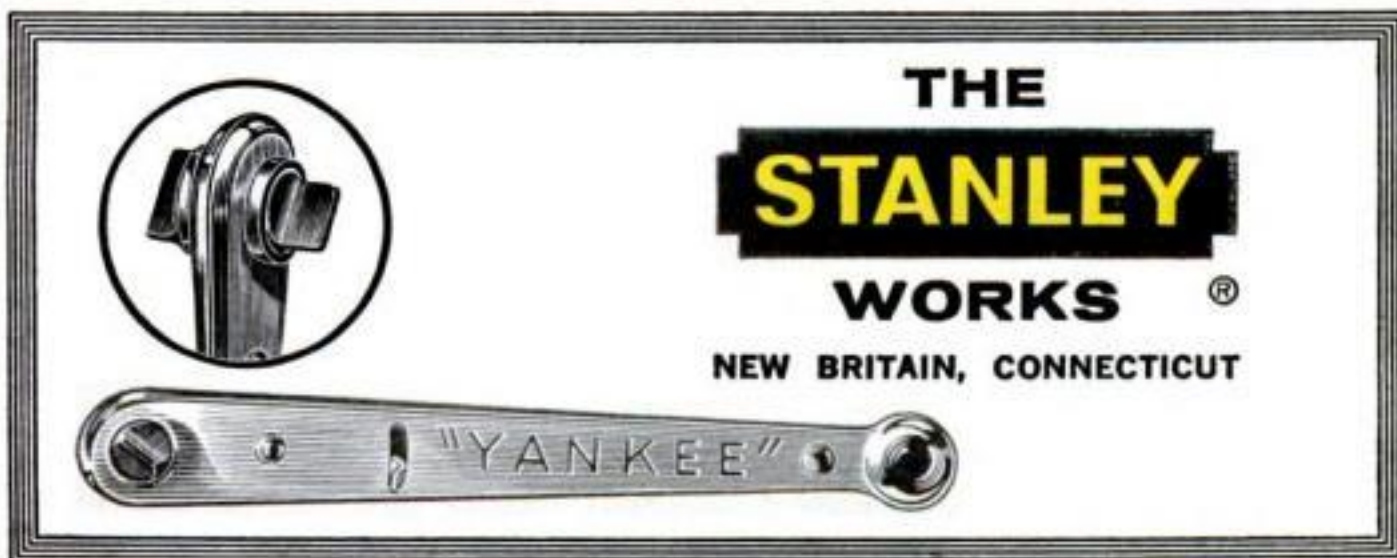
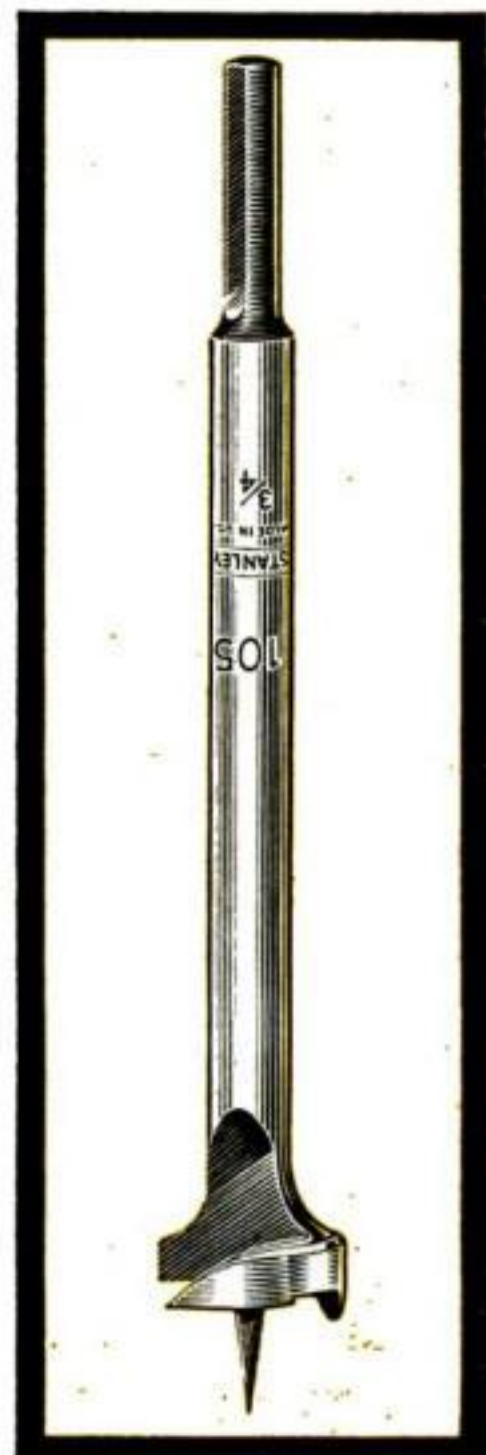
PUSH DRILL — Why do it the hard way? Here's a tool for one-hand drilling. Easy? Just one push and the hole is started. Spring action promptly returns drill for the next stroke. No. 41-Y.

DRILL BIT — You've never seen its equal for drilling holes...fast, clean, smooth, true!... Clears chips from work. No. 105.

OFFSET RATCHET SCREW DRIVER — Best there is for working in tight spots...gets in close! Vest-pocket size, but with full-size power. Thanks to ratchet mechanism, point or tip need not be removed from the work until screw is driven home. No. 3400.

See these at better stores everywhere.

STANLEY—THE TOOL BOX OF THE WORLD



THE
STANLEY
WORKS®
NEW BRITAIN, CONNECTICUT

Jim Roe Tests All the MerCruisers

[Continued from page 121]

choice, boating fun may still be possible.

We launched easily at Fort Myers, assembled our equipment, and headed for the other side of Florida. There were four in our party—my wife, test driver Odell Lewis, photographer Ed Finley, and me.

We had chosen this route for a specific reason. It gave us a wide variety of water in which to observe the handling characteristics and capabilities of the stern-drive unit. We'd have a touch of the Gulf, a stretch of the Caloosahatchee River, the Caloosahatchee Canal, then temperamental Lake Okeechobee; and after that, the St. Lucie Canal, the broadening St. Lucie River, the Intracoastal Waterway, and the Atlantic Ocean. And the 150-mile trip would be punctuated with maneuvering into and through three locks.

The countryside goes through almost unbelievable changes. Part is jungle-like growth down to the water's edge (an obliging alligator showed up along this stretch). Part of the way is lined with orange and grapefruit groves. Part is swampy. And many miles of the run make you think you are in Nebraska or South Dakota—with rangy cattle atop low ridges and standing belly-deep along the shore.

Skipper trouble. At the Ortona Lock I ran us aground (with great skill!) while killing time circling, waiting for the lock tender's return from lunch. But one of the MerCruiser's happy talents turned the potential problem into just an interesting incident. We raised the stern unit with a hand crank and let the current drift us off. No pushing, wading, or damage to boat or disposition. This was a MerCruiser II; the III is raised hydraulically.

After an overnight stop at the Clewiston Inn, we renewed our 35-mile-an-hour navigation of central Florida, speeding down the Okeechobee Waterway. Then we headed into the open stretch of Lake Okeechobee at reduced speed. The wind was down from the day before, but the surface of the lake was still too rough for speed. Boat and motor handled like a lady. They were handled *by* a lady, too, since my wife took her turns at the wheel in both the canals and the open lake. We stopped for lunch at the Indiantown Marina along the St. Lucie Canal, then took off nonstop for the Palm Beach docks.

One of the best reports one can give of

a long run at high speed in a small boat is that it was all fun—no problems. Except for my running us aground, that's how it was—a fine boat ride, the engine never missing a beat, our small tool kit untouched.

Behind the paint. Uneventful boating is always preceded by eventful engineering. Examples show up when you look behind the paint job of the MerCruiser. It's made of tough alloys, protected by shock absorbers and rubber cushioning. The transom mounting bracket spreads the operating stresses over a wide area. Safety mercury switches momentarily cut out the ignition if the power unit tilts up on impact from an underwater obstacle, then release and cut the ignition in again as the unit comes down. A neat little trim tab does extra duty. It adjusts to neutralize side pull from propeller torque, and it serves as a sacrificial anode to reduce underwater galvanic corrosion on other, more expensive, metal parts. The 42-amp marine alternators kick out plenty of power for radios and other instruments.

On the MerCruiser I and the MerCruiser III, the water intake is integral with the drive unit, and exhaust gases are released through the propeller hub, to be carried well astern before they even reach the surface. Anyone who has idled a diesel-powered boat with standard exhaust through a long channel—or driven behind a bus in traffic—will give a huzza for this system.

Steering controls—and all throttle and gearshift controls—are inside the boat and out of sight under the motor hood. The propeller is splined to the shaft, eliminating shear pins. Power-train parts are protected against overload—from impact or inertia—with a neoprene-cushioned safety clutch. Under severe impact it slips momentarily.

A geared position-indicator is built into the steering-wheel hub to tell you at a glance the direction the boat will turn.

Fresh-water cooling has been provided for operators in salt-water areas.

Finally, the entire drive unit has been engineered so that it can be easily removed for servicing without disturbing the engine.

This sort of thoughtful design—combined with rugged testing at Lake X, salt-water testing at Sarasota, and extensive testing in long high-speed races—has produced a breed of power packages that can take it and keep on taking it. ■ ■



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IGA

mixing poisonous chemicals with water. You are less likely to walk into a cloud of dust than into a fine mist of spray.

The mixing of concentrated spray insecticides with water calls for utmost caution. Any you spill on the hands, floor, or ground must be cleaned up immediately. Left-over spray can't be stored in your sprayer because it rapidly corrodes the equipment. (Dusts can be left in the dusters, but label the equipment so you will remember what is in it.)

Granular insecticides: Granular insecticides are among the safest to apply, but their uses are limited mainly to treatment of lawns and ground areas. In these products the active insecticides are mixed with a bulky inert mineral carrier such as vermiculite.

Some gardeners object to granular materials because they are bulky. But bulkiness is a distinct safety advantage. A child who tries to eat a granular pesticide would probably gag on the harmless and unpalatable carrier before he could take in enough of the toxic ingredient to kill him. On the other hand, a few drops of spray concentrate or a little dust might kill quickly.

Insidious systemics: If your gardening activities extend to the operation of a greenhouse, and especially if you grow African violets, you may already be familiar with systemic insecticides. In any case you should know about them—and leave them alone.

These very potent chemicals (sodium selenate, Systox, Demeton, OMPA, Schradan, Lethalair) are sprayed on plants or more commonly are applied to soil around the plants. The poison goes *into* the plant system where it is ready to kill attacking insects.

Systemics are extremely toxic when absorbed through the skin or if inhaled.

Even if you never buy these insecticides, you may inadvertently get into trouble with them. Never buy discarded topsoil from a greenhouse operator unless you are certain he has never used systemic poisons. Once applied, these poisons remain in the soil a long time; should you or someone else grow vegetables in such contaminated soil, the food could be deadly.

The problem of disposing of soils contaminated with systemic insecticides brings up a fine point of gardening ethics. If you

dump such soil into an area of your property that you plan never to use for growing plants, you may nevertheless be setting up a deadly booby trap for others who someday will own and use your property.

Many people view the entire problem of pesticide use (not systemics alone) with apprehension because future generations may be forced to live with contaminated soils.

Fantastic foggers. In many communities, trucks roam the streets, shuttling in and out of driveways to belch huge clouds of insecticidal fog. This drastic solution to mosquito and other bug problems is so questionable that insecticide manufacturers are among those who condemn it.

What about automatic foggers designed to keep gardens, patios, poolsides, and other outdoor living areas free of flying insects? Some devices are portable, electrically powered. Others are designed for semipermanent placement.

Are they safe? Perhaps the most questionable are units attached to lawn-mowers. These blend noxious gasoline exhausts with the insecticidal fogs.

Makers of other types of units emphasize that the sprays recommended for use with them are of the nontoxic type. If you must fog, choose one of these insecticides and keep it off children, food, and your neighbor's property.

Some advertising of fogger equipment is irresponsible. The manufacturer of one portable, electrically operated fogger who suggests that his equipment be used everywhere outdoors—at the pool, patio, barbecue area, etc., recommends the use of an oil-based (probably inflammable) insecticide—while a label on the chemical itself warns, in fine print, that the contents should not be allowed to reach children.

The advertising goes on to suggest that any oil-based insecticide can be used, and that the same equipment can be switched over to general garden spraying.

If you can paint insecticide into crevices where insects travel, don't spray entire counters and floors. If you can swat one fly or mosquito, don't mist spray all over the room.

If you have any reason to question whether or not a product is safe to use, let someone else find out, one way or the other. You play it safe—indoors and out. ■ ■

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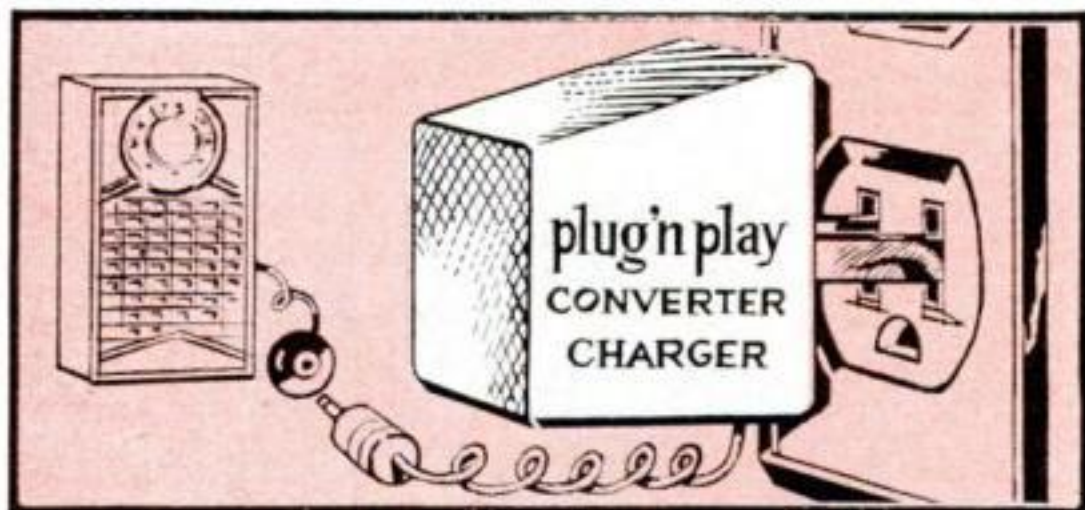
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formance from your transistor radio with the same batteries *for up to two years*—and all for as little as 5¢ worth of house current.

Proven effective! Five of the largest U.S. radio manufacturers and two overseas radio makers are installing the Plug'n Play in new models. Now, this invention by Dynamic Instrument Corporation is available to Popular Science readers to install themselves quickly and easily on their present transistor radios. **SAFE!** Plug'n Play is proven absolutely safe, shock proof. U.L. Approved. **Satisfaction guaranteed!** We will replace it or give a full refund if returned

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(2) Lead the two fine wires out any convenient side and close radio cover with adapter ball-jack exposed. **FREE EXTRA:** Enclosed is a small drilling tool and instructions for drilling a hole through the radio case to make your own factory-type installation of the jack. (3) Install male jack into female jack contained in the small adapter ball instantly whenever you wish to charge the batteries or to play the radio on house current.

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shoulder at the small end, and saw $\frac{1}{4}$ " off the square key. Mount small-end-first on the motor shaft, and insert the key.

Motor mounting. If the mower-shell mounting hole is small, make a cardboard template to match the four motor-mounting holes and the shorted solenoid terminals. Drill four $\frac{1}{4}$ " holes in the shell to match—carefully centering the motor in the shell. Drill $\frac{1}{2}$ " holes to pass the brake-solenoid terminals. If the motor hole is large, mount the motor on $\frac{1}{2}$ " aluminum angle stock with $\frac{1}{4}$ "-by-20 bolts. Make certain that the blade maintains the same distance from the ground for 360-degree rotation. If the motor is other than horizontal, the swaths cut in the grass will be uneven.

Mower blade. Purchase a mower blade with a $\frac{3}{8}$ " hole, at least $\frac{1}{2}$ " shorter than the inside diameter of the shell. Make a leather or cork washer with a $\frac{3}{8}$ " hole, about 2" in diameter. Back it with a metal washer of the same size, and fit the two together on the motor shaft, as shown. Add a $\frac{1}{2}$ " metal washer and use the original shaft nut to complete the assembly. Do not omit this or similar assembly, as the motor could be permanently damaged if no slip is provided should the blade hit a solid object.

Converting a generator. The Delco generator listed as an alternate motor choice will perform quite well with a few minor changes to make it operate as a motor.

Remove the end-bell dust shield and dust strap. Remove the terminal screw from the brush holder with the heavy black insulated wire attached. Lift the brushes from their holders part way, until the pressure spring holds them away from the commutator.

Remove the two long end bolts, and withdraw the entire end assembly from the generator. Remove the screw that fastens the flexible insulated wire to the inside of the frame. Pull the locator pin from the end of the generator frame, and replace the end assembly. From a beginning position with the locator-pin holes aligned, rotate the end assembly on the frame $1\frac{1}{2}$ " clockwise.

Put a large washer on each of the long bolts. Replace the bolts, but through the large open portions of the end assembly instead of the original holes. Tighten the bolts snugly. Drill a $\frac{3}{8}$ " hole about $\frac{1}{4}$ " deep into the generator frame, using the

locator-pin hole in the end assembly as a guide. Drive a nail of proper size firmly into the hole, and saw it off flush.

Replace the brushes in their holders, contacting the commutator. Put the dangling brush-wire terminal, the stiff-wire terminal, and the flexible-wire terminal (previously grounded to the inside frame) together and screw them tightly to the brush holder. Be sure the brush can move freely. Replace the dust cover and dust strap. The "generator" is now a motor.

Remove the terminal-board cover, and run a heavy flexible wire to the terminal marked "A+." This is the main, heavy-current connection to the lawn-mower relay. Install a 20-ohm, 10-watt resistor from the "F" terminal to the motor chassis. Replace the terminal-board cover.

Make a hub for the mower blade by fitting a 4" cast-iron keyway pulley on the shaft. Buy a blade with a $\frac{3}{8}$ " hole, and slip the blade up against the pulley face, first covering the pulley face with a leather washer. Back the blade with a large-diameter heavy iron washer with a $7/16$ " hole. Tighten the castellated nut securely.

Here are addresses of a few companies handling surplus DC motors and generators.

Palley Supply Company, 2263 E. Vernon Ave., Los Angeles; Airborne Sales Co., 8501 Stellar Dr., Culver City, Calif.; Surplus Center, 900 West O St., Lincoln, Nebr.

Battery and charger. Unless you are thinking of mowing an acre or more at a time, a small battery is preferable, although not smaller than 20-ampere-hour rating. Using $\frac{3}{4}$ " do-it-yourself aluminum angle stock, make a rectangular frame to hold the battery. Mount on the mower shell to the rear of the motor.

The charger can be built into the case of an automobile generator regulator to physically match the appearance of the relay. Remove all parts except two terminals by drilling rivets with an oversized drill, and by careful use of a hacksaw. Mount the small transformer at one end, and the silicon rectifier at one corner of the other end. Carefully measure the space requirements for the male socket, fuse holder, neon indicator, and rheostat. Mount these items in the regulator cover. Connect components as shown in the wiring diagram. Use the terminals for charger connections to the battery. In wiring between the cover



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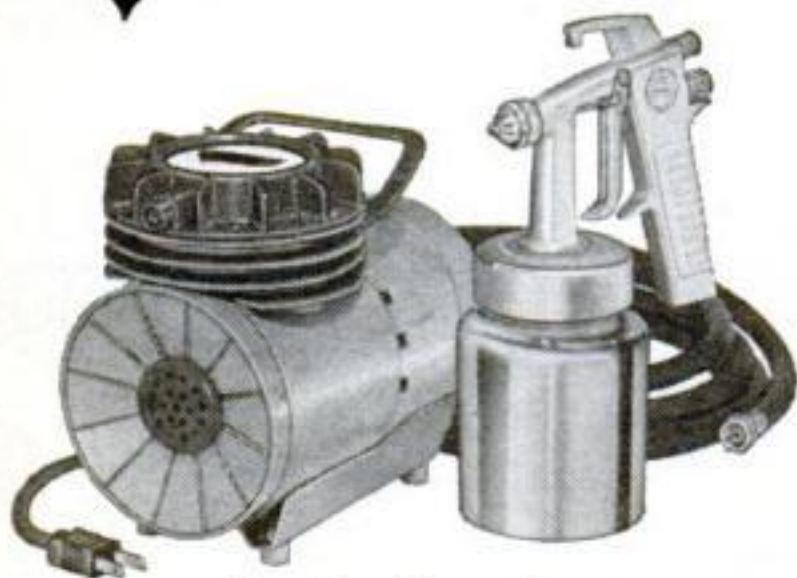
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How to Build a Battery-Powered Lawn Mower and the chassis, use wires long enough to permit the cover to lie beside the chassis when the box is open, and carefully fold them into available space as the cover is replaced.

Mount the charger on the mower shell alongside the motor, with the male socket facing outboard, and connect two insulated wires to the charger terminals. Use ¼" terminals on these wires for connection to the battery. Make absolutely certain that the correct polarity is respected before connecting the charger to the battery—reversed polarity will destroy the silicon rectifier in just a few moments. The *positive* charger terminal must be connected to the *positive* battery post. Use a DC voltmeter to check polarity.

Key switch and relay. Since the motor will draw from 20 to 40 amps at starting, and most key switches carry only two or three amps, a heavy-current relay is required to connect the motor to the battery.

Only the large-contact, cutout relay, of the three to be found in most regulators, will be used. Cut the heavy-current winding from the relay solenoid, taking care not to cut the inner, fine-wire winding. Solder a jumper from the "F" terminal of the regulator to the moving-arm portion of the cutout relay. The "BATT" and "F" terminals now form the heavy-current breaker for the motor. The "A" terminal should have a fine wire leading to the relay solenoid—leave this connection intact. The "A" terminal is the solenoid connection to the key switch. The other end of the relay solenoid is internally connected to the relay frame (which is insulated from the regulator chassis). Connect the relay frame to one of the battery posts.

Mount the relay chassis on the mower shell opposite the charger, leaving the rubber mounting grommets intact to insulate the relay from the mower. Replace the regulator cover. Mount the key switch at a convenient location, either on the motor frame or on the mower handle. Thread the two key-switch wires to prevent points of wear which would cause a short. Terminate one wire at the "A" terminal of the relay, and the other wire at the battery post opposite that to which the "BATT" terminal is connected.

Final preparation. Make all motor and battery connections with heavy, rubber-insulated wire. While making connections,

How to Build a Battery-Powered Lawn Mower

make certain that feet, hands, and other objects are clear of the mower blade: Serious injury could result from accidental starting of the mower. After all connections are made, a turn of the key should start the mower.

A few checks should be made for safety. Make certain that the charger 115-volt input is not grounded to the mower shell, by taking readings from the mower shell to "ground" (water pipe, for instance) with an AC voltmeter. Reverse the charging plug in the wall socket and take a second reading. Any voltage indicated is evidence that a short exists in the primary of the charge circuit.

To set the charging rate, connect a 500-milliamp meter in series with the charger lead. From the minimum setting, adjust the rheostat for a reading of 250 ma. Use a ¼-to-2 amp fuse in the fuse holder.

Keep the key on your key ring or in an out-of-the-way place to prevent its use by a child—the mower is very, very easy to start. ■ ■

Inside the World's First Pushbutton Prison

[Continued from page 55]

in the cell areas. In front of each row of cells will be four separately operated, wall-mounted "group-control" sets. With a flip of a switch in the message center, these can be changed from P.A. speakers to microphones.

Even closer audio supervision will be kept over the 10 "absolute maximum security" cells being built in one cell block to house incorrigible, unruly convicts of Alcatraz caliber. Individual microphones will be installed over each of these cells, piping to the message or control center not only the sound of ordinary conversation but such foreign noises as the faint rasp of a hacksaw blade or the surreptitious removal of an air-duct grating.

Chances are slim that such sounds will ever be made, for sawing one's way out of Marion would be a lifetime career. Concealed in the louvers of the penitentiary's unique, aluminum, jalousie-type windows will be inch-thick horizontal steel bars. They are so hard that in one test some 1,200 hacksaw blades were needed to make just a ⅛-inch dent.

If a prisoner tries to escape through the utility distribution tunnels beneath the cor-

CONTINUED

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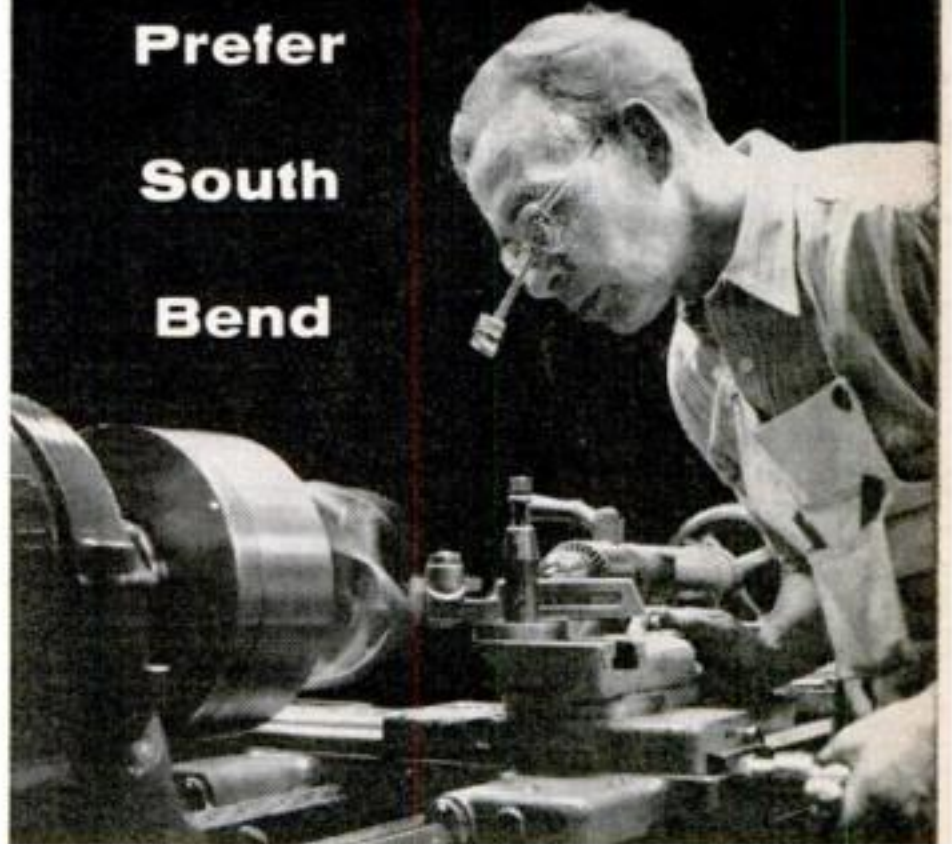


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Inside the World's First Pushbutton Prison
ridors, he'll find himself confronted with an invisible stool pigeon. Sound detectors will be installed throughout this unpatrolled area. If the pattern of supersonic waves these devices emit is broken by a man walking past, an alarm will sound in the prison's nerve centers. The location of the detector, indicated by a flashing light, will tell guards exactly where the would-be escapee is.

Another conventional underground escape route—through sewer pipes—is precluded by the pipe design used at Marion. Several hundred feet from the pinwheel of buildings, the prison's massive sewer main empties into a giant concrete chamber. The sewage will rush from there through several pipes only eight inches in diameter into another tank. Then the big main resumes.

Finally, the site will have 20-foot-high concrete walls on three sides; the remaining side, where visitors enter through the Administration Building, will have two 12-foot-high chain-link fences set 20 feet apart. A low-voltage pressure-sensitized trip wire on top of the walls and fences will ring the 29½ acres occupied by the prison. Touched by an inmate trying to scramble over, it will electrically set off visual and audio alarms in nearby guard towers and in the message center.

Searchlights, too. A potential fence climber, however, would no doubt be spotted from one of the six mushroom-shaped guard towers or the roof-top message center long before he reached the trip wire. Atop each 35-foot tower will be a powerful swivel spotlight with a 200-foot range. Around the shaft of each tower will be four 300-watt floodlights prefocused on the ground. And lighting the fences will be 28 mercury-vapor lamps on arched poles, placed so they can't aid in climbing.

The locked guard towers will be linked by an intercom system, and conversation between lookouts will be automatically broadcast to the control and message centers. Also monitored will be reports from an officer who at night will continually circle the prison in his car. He will talk to tower guards through an intercom and will communicate directly with the message and control centers.

Getting in. If you don't belong there, getting into the penitentiary will be about as hard as getting out. All commercial trucks and visitors' cars will be stopped at

Inside the World's First Pushbutton Prison
a "rejection circle" on the perimeter of the prison grounds. Occupants will state their business to a guard in a nearby tower by talking through one of three microphone-speaker units, similar to those used at some drive-in restaurants. The guard will relay the information to the message center, which will clear or reject visitors.

The emphasis on electronics and modern design is not the only radical feature of Marion. The construction is also unique to Federal maximum-security institutions.

Most of the buildings are being erected with seven-foot-wide (cell width) reinforced-concrete slabs which are precast and prestressed at a Kentucky plant and trucked to Marion. The 18-foot-high "sandwich panels," which are poured in a horizontal position one layer at a time and then steam-cured, consist of 4 inches of interior concrete, 1½ inches of insulation, and 2½ inches of aggregate for the exterior. Once they are swung into place with power equipment, they are joined by a nonshrinking grout.

The security needs of Marion called for the development of many new construction ideas. Straight electrical conduits, for example, can't be run between cells because inmates might remove the receptacle plates and push notes or contraband through. So each conduit contains at least one 90-degree bend. And at every point where ductwork penetrates a floor, grilles must be installed to thwart any attempts to hide there or escape through it.

Special two-headed screws are being used throughout. Once such a screw is in place, the top head (containing the slot) is chiseled off, leaving a slotless lower head. The screw then can be removed only with a drill.

Because Marion will be the most up-to-date prison in the world, it seems only fitting that it has been chosen to inaugurate a unique academic program.

At Southern Illinois University at nearby Carbondale, officials, led by SIU President Delyte W. Morris and famed Penologist Myrl Alexander, are establishing the nation's first full-scale criminal correction center for the study of criminology and the training of prison personnel.

Marion's staff can take graduate work in criminology and penology, and students interested in prison work will be able to use the penitentiary as a clinic in which to perform their "internship."

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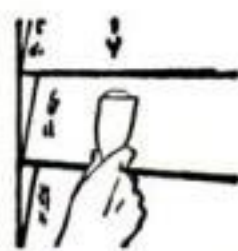
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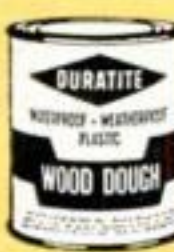
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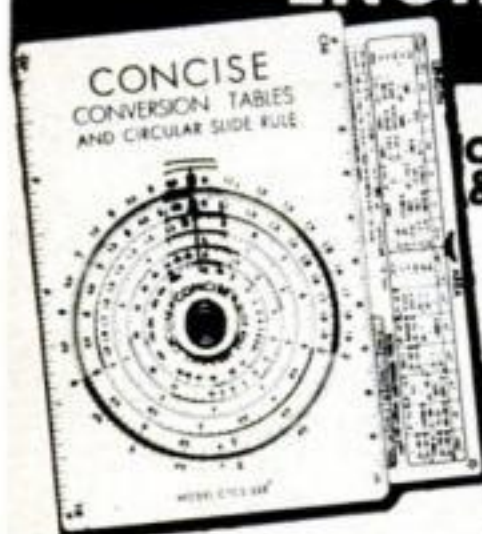
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Ranger 6, Where Are You?

[Continued from page 68]

burg. At a word from the operations chief, the servo men adjust the aim of the antenna.

"L plus 12 hours and 30 minutes . . . exactly," his voice intones.

Suddenly a needle jumps on the acquisition board.

Unseen, a dab of electrical energy has punched through 82,000 miles of space, bored through the earth's atmospheric buffer, been caught by the antenna's mirrorlike dish. Reflected into an unbelievably sensitive receiver, it has been amplified into energy enough to flick the needle.

"RF lock!" you announce, alerting the others. You've caught the signal just as it grazed the horizon.

Tuning in. Quickly you tune the receiver close to 960 megacycles, the spacecraft's transmitting frequency; the received frequency is a little off, due to the Doppler shift. A high-pitched squeal in your earphones tells you the antenna is not aimed precisely enough. You won't really be on track until you can eliminate the squeal.

During the next 60 seconds you tune, snap hour-angle and declination changes to the servo men, and check a dozen meters on the board. Outside, the big parabolic antenna moves gently; a two-to-three-degree error could mean losing the Ranger probe in space.

But it's all right. "Locked on transmitter," you report.

Now Goldstone's own transmitter pulses control signals to the spacecraft, ordering its receiver to lock onto the ground station.

Seconds later the operations chief orders: "Automatic!" With a flick of a switch, you set the antenna to follow the probe obediently across the sky for the next 12 hours. You lean back to let tension ebb away, feeling pretty pleased with yourself.

The risk of losing the spacecraft is greatest on the first pass, when the overlap between two tracking stations is slight. As the probe gets farther out, Johannesburg can hold track for over an hour while you're acquiring the signal. During the 66-hour flight of a Ranger to the moon, the probe appears to rise in Goldstone's eastern sky three times, due to the earth's rotation, although it's actually maintaining a steady course outward from the earth.

That's how it will be during the flight of Ranger 6, this fall, according to JPL's Dr. Eberhardt Rechtin, director of NASA's

Ranger 6, Where Are You?

Deep Space Instrumentation Facility, the official name of the three-station tracking net.

The network has successfully tracked our deep-space probes to date—the Rangers and Mariners—bringing back the second Mariner's telemetered data on Venus. Next on the agenda is a series of Ranger instrument probes to be impacted on the moon; this is to be followed by a series of Surveyor probes that will make soft landings on the moon, preparing for the manned Apollo mission.

The extreme sensitivity necessary for deep-space tracking has been designed into Goldstone's receivers.

Radio-frequency "noise" is one of the big problems in receiving messages from space. That's the electronics engineer's word for a number of things, some of which most of us would call interference. To avoid some of the noise, deep-space antennas are located in isolated spots, far from power lines, industrial centers, and highways that send out man-made interference. Picking up a weak signal from space, the parabolic antenna acts like a telescope mirror to focus it.

An important part of the Pioneer antenna is the "Cassegrain horn" that juts up from its center. The signal concentrated by the dish bounces off a convex reflector into the mouth of the horn, which further concentrates it—and incidentally shields the focal point from noise crossing the lip of the dish. Now the problem is to distinguish the signal from noise produced by natural radio sources in space and electrical activity in the atmosphere. To do this, it's essential to have a receiver with very low "system noise"—the sort of noise produced by the random motions of electrons and atoms in the circuits.

Amplifying by maser. The signal emerging from the narrow end of the horn is directed to a ruby maser—the most sensitive and noise-free kind of amplifier. Its heart is a synthetic ruby crystal cooled to minus 452 degrees F. by liquid helium. At this temperature, random motions of the atoms in the crystal are virtually stopped; electrical activity in the crystal is stimulated only by the incoming signal. Noise in the receiver's circuit is only 1/60 of that produced by the best amateur radio equipment.

That's the secret of Pioneer's ability to receive weak signals from far out in space.

CONTINUED

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Ranger 6, Where Are You?

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The key is a set of four small dipole antennas, similar to ordinary TV antennas, mounted in a ring around the convex reflector above the mouth of the horn. All four pick up equal amounts of radio energy only when the dish is pointed right at the signal source. If the aim is slightly off, one dipole or another will pick up more energy than the others. This difference, amplified, energizes solenoids that switch the antenna's hour-angle and declination servomotors on and off, constantly aligning the antenna with the signal and following the course of the spacecraft.

The receiver system is also capable of measuring the spacecraft's speed. This it does by keeping track of the Doppler shift in the frequency of the signal sent out by the transmitter aboard the probe. With information on speed and direction available, it becomes possible to compute the spacecraft's course and see if it's correct. If not, the Echo transmitter sends commands to the spacecraft, ordering it, first, to point in the right direction (by means of small gas jets), then to fire its built-in course-correction motor for just long enough to set it right.

Orders from the computers. Worked out by the computers at Pasadena, the orders come over the teletype at Goldstone. Three separate teletype wires are used, each carrying the same orders, to make sure there's no error. The orders are strings of ones and zeroes. A typical command may look like this:

1-01010-010111100011

Cryptic to us, this instruction in binary code is meaningful to a spacecraft's control circuits. Once received and verified at Goldstone, a series of commands is punched into paper tape and transmitted to the spacecraft at the push of a button.

At your tracking console, you watch to see that the command is obeyed by the probe out there in space. As your instruments indicate that its course has changed, you go through a modified acquisition procedure again, flip the controls to automatic track, and check the new heading.

If all goes well, you are now in a position to be the first to receive the latest news from the moon, as the Ranger probe sends back man's first close-up pictures of its mysterious surface. ■ ■

When Boats Had Wings
[Continued from page 79]

lesser craft. It was nearly 22 feet long, 9½ feet wide, and provided 6½-foot headroom. It had wall-to-wall carpeting. The flight officers sat at their controls or instrument panels in handsome leather-upholstered chairs.

Below, the passenger deck was divided into 11 compartments. One was a dining room, seating 14 at 5 tables. On the early, prewar flights, English passengers usually dressed for dinner. The cabin farthest aft was a luxurious bridal suite.

The Yankee Clipper usually flew only 40 passengers on overnight flights, when its eight-foot berths were made up. By day, it could accommodate 74.

Pan Am had Pacific Clippers, too—Martin M-130s—one of which, a China Clipper, made the first scheduled air-mail flight from California to Manila in November, 1935.

With the coming of war, all Clippers immediately joined the Navy, though keeping their civilian crews.

The news of Pearl Harbor was flashed to the Philippine Clipper just after it had taken off from Wake Island, headed for Guam. It swung back to Wake, minutes ahead of the first Jap attack. Before it was ready for takeoff again, it was punctured by 97 bullets. Still, stripped of all furnishings and carrying 70 civilians, it managed to hobble safely to Midway and Honolulu.

The Atlantic Clippers carried a dazzling roster of VIPs during the war years, and incredible tons of high-priority mail. One took President Roosevelt to Casablanca.

The Yankee Clipper that cracked up in the Tagus River, at Lisbon, in February, 1943, with Jane Froman and other celebrities aboard, had already made 240 safe crossings of the Atlantic.

Pan Am's last flying boats were withdrawn from Atlantic service on Aug. 9, 1945, from Pacific service April 16, 1946. A few wartime Catalinas—civilian versions of the successful PBYs—are still flying up and down the Amazon for a Pan Am affiliate.

Flying workhorse. All previous flying boats were put in the shadow by Glenn L. Martin's whopping, 70-ton Mars, produced for the U.S. Navy in July, 1942. It was intended to be a bomber. Instead, like many a war recruit with dreams of heroism, it was obliged to accept a much humbler, though useful, role. The Mars became the

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When Boats Had Wings

Navy's biggest flying cargo carrier. On its first war mission, hauling as much as 35,000 pounds at a hop, it covered 8,972 miles in 55 hours and 31 minutes of flight. During the trip, to bases in South America, it did one nonstop stretch of 4,375 miles, a world record at the time.

The wing of the Mars spread 200 feet. A two-deck hull contained as much space as a 15-room house and was slightly more than 117 feet long. Its four 2,000-hp. engines drove it through the skies at speeds up to 180 m.p.h. They spun three-bladed propellers 17½ feet in diameter, the biggest then made.

Martin followed up this huge workhorse with an even bigger one—an 82½-ton model called the Caroline Mars. It had four 3,000-hp. engines and a top speed of 238 m.p.h. It performed a spectacular feat that may never be equalled.

On May 19, 1949, the Caroline Mars transported 301 passengers and seven crewmen on a single flight from San Francisco to San Diego. The passengers were naval personnel. They made the 500-mile trip in 2 hours, 54 minutes, probably all breathing shallowly. This was, and may forever be, the world passenger record for airplanes.

In 1944, Glenn L. Martin had declared there was no limit to the size to which a flying boat could be built. Three years later, it seemed as if Howard Hughes was trying to prove that.

Wooden Hercules. In November, 1947, Hughes slid out by far the largest flying boat ever made anywhere. Called the Hercules, it seemed to justify its name in every dimension. Its gross weight was 150 tons. Its wingspan was a breathtaking 320 feet. Its hull was 220 feet long, and looked like a vehicular tunnel inside. Press agents said it could carry 750 people—all standing, naturally. It had eight engines. Its range was supposed to be 3,000 miles, its top speed 218 m.p.h.

Not the least astonishing fact about the Hercules was that it was made of plywood. That was because it had begun as an early wartime project, when metal was scarce.

In 1944, when metal became plentiful, the Government canceled its original contract for three of these enormous wooden flying boats.

Hughes kept on. In 1947, he was under investigation by Senate probers. They wanted to find out what he had produced

When Boats Had Wings

for \$18,000,000 of the Government's money and \$7,000,000 of his own.

Hughes had melodramatically vowed to go into exile if the Hercules wouldn't fly, and on Nov. 2, 1947, he proved that it could. Just barely.

It was a blustery Sunday afternoon. Hughes was at the controls of the vast flying boat. After three takeoff attempts, the Hercules lifted off Long Beach Harbor and flew about a mile—at 70 feet.

"It felt so buoyant and good, I just pulled it up," Hughes said afterward. He put it down again quickly enough, however, and the plane has never flown since.

Royal entry. The forlorn distinction of being the last of the great flying boats belongs to Britain's Princess.

This two-deck craft has a curious, curvaceous, "double-bubble" hull, 148 feet long; a wingspan of 219½ feet; a gross weight of 172½ tons. With 10 turboprop engines, she was expected to carry as many as 220 passengers across the Atlantic.

Instead, the Princess had the misfortune to be ordered in 1946, just when Lockheed Constellations and other comparable land planes were beginning to put flying boats out of business.

The first of three Princesses made her debut Aug. 22, 1952. Her engines were felt to be inadequate. B.O.A.C., which had ordered the turboprop giants, meanwhile had retired its last regular flying boat from service and decided to use only big land planes for transoceanic flights. The story got around that the R.A.F. would take over the Princesses for military transport. That never happened, either.

Instead, the only Princess that ever flew, and her two sister ships, went into cocoons on the Isle of Wight. There, at last check, they still were. But an American Prince Charming may reawaken them. The Winder Aircraft Corp., of Dunnellon, Fla., bought all three from the British Government last year. Joel Henry, head of Winder Aircraft, has told POPULAR SCIENCE that he plans to convert them into nuclear-powered flying boats. Certain modifications will first be made on them in England, and then Henry plans to have them flown to Florida for the main conversion.

Will the giant flying boats, mated to atomic engines, emerge again as queens of the transoceanic air lanes? Only time can tell. ■ ■



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Pry Bars: Lift 5 Tons or Pull a Nail

[Continued from page 104]

end—the blade. This can jack about a ton of furniture or machinery $\frac{3}{4}$ " off the floor for leveling or shimming. You need about $\frac{3}{4}$ " clearance to slip the blade in. The electrician's cutting chisel, described later, serves as a wedge for the needed gap here.

The straight ripping bar. This is "straight" only by comparison with the gooseneck bar. Actually, it's angled about 30 degrees from each tip, providing about a 3" offset. It's used in the same way as the gooseneck in wrecking except that it can pull nails in shallow spaces where the gooseneck can't operate. It's priced a few cents lower than the gooseneck.

The ripping chisel is really a short ripping bar (about 18") with a wide, bevel-ground blade notched for nail pulling. A blade-to-shank angle of about 10 degrees permits easy hammer-driving, but still provides a slight "rocker" for nail lifting.

One type has a squared-off shank end for hammering like a cold chisel. Another, an "offset" type, has a second blade at right angles to the shank in place of the squared end. As both tools are high-carbon-steel drop forgings, you can hammer this angled end without fear of damage. Typical prices for 18-inchers are \$2.10 for the straight model and \$2.65 for the offset, which is the handier of the two.

The stripping bar has a solid blade at each end instead of a nail-pulling slot, as it's designed for stripping forms from poured concrete. The bends at its ends are much less sharp than the gooseneck bend. You can pry close to a vertical surface, as in lifting the end of a piano or freezer to insert a dolly or caster. A 36-incher lets you lift a quarter ton 2" to 3". Price of a yard-long bar: about \$4.50.

The jimmy bar, famous as a burglar tool, may get its name from a long-outmoded British riding boot called a "jemmy" in which the tool could be concealed. In its common form it has a round drift-pin taper at one end and an angled pry blade at the other.

It's a useful shop tool, especially in metalwork, where the taper lines up bolt holes, and the blade lifts parts for shimming. In the usual 14" or 16" length, it provides leverage in tight spots, as in inching a marine engine into bolting position on its bed. A 16-incher costs about \$1.75.

The nail claw, drop-forged from the same high-carbon tool-steel hex stock as the big

Pry Bars: Lift 5 Tons or Pull a Nail

bars, has pointed claws ground to a chisel edge. You can drive them under a sunken nailhead by hammering on the back of the claw bend. To pull the nail, you simply rock back on the shank. It works on nails up to about 20-penny size, pulling small ones completely, and lifting larger ones more than an inch for final pulling with a gooseneck. Usually about a foot long, nail claws cost around \$1.80.

The crowbar, toughest and best known of all, is strictly for the heavy jobs. Its double-beveled business end is too thick and blunt to wedge in tight joints like a ripping bar, and there's no end angle to provide a built-in fulcrum. So you have to lever it over something for a lifting or prying action.

With a 60-incher, ordinary muscle power lets you exert a prying force of around five tons. You buy crowbars by the pound, not the inch. They range from 10 to 26 pounds at prices from about \$4.75 to \$11. For home and shop use, a 14-pounder, which usually measures about 4', is the best all-around buy at about \$6.50. It can lift heavy machinery, pry boulders out of your lawn, or break through a concrete floor if you bounce it vertically. It's also the old-timer's tool for easing a boat cradle along greased timbers.

The electrician's cutting chisel, a one-piece drop forging, has a wide, knife-edged blade that can be driven between flooring strips to shear off the tongues. This permits flooring to be lifted to get at wiring underneath. Blade thickness increases from a knife edge to about $\frac{1}{4}$ ", so it's also an excellent wedge. Drive it under the base of heavy furniture or appliances and it opens space for a larger bar blade. And the broad blade spreads the load, minimizing pressure marks. Overall length of the tool is about 8". Typical price: \$3.85.

The floor and clapboard chisel, another one-piece forging, is about 18" long so it can slip under the full width of a clapboard to pry it out. Its blade is about an inch narrower than the electrician's chisel. It's a good tool for opening a crate. Just drive it into a nailed joint and pry.

Both chisels are convex-ground like an axe to a keen wood-cutting edge, then heat-treated to slice unhardened nails, too. Typical price of a floor and clapboard bar chisel: \$3.30.

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Pry Bars: Lift 5 Tons or Pull a Nail

cupped blade is set under a doorknob or latch, and the jointed leg adjusted to reach the floor and hold the bar at an upward angle. A husky pull down on the 5' handle pops the catch up and in, opening the door. The fireman's window jimmy has a reversible pivot link attached to add prying or lifting force. For obvious reasons, you can't buy one of these over the counter.

An auto-body repairman's bar can often handle home-shop jobs where nothing else will work. Small bracket bars resemble flat wrenches. The slot (that would fit the nut) is cut to slip snugly over bumper-bracket stock. A 20"-to-26" handle gives enough leverage to bend the bracket to shape. The bumper bar, usually 4' to 5' long, does the same job on the bumper. It's often used to free a jammed wheel from a bent bumper.

But it's the railroaders who get the most out of leverage. A pyramid-pointed 5' "lining bar" digs into roadbed rock ballast to pry unwanted curves out of wavy track. A 5' "claw bar" yanks spikes from ties. King of them all is the "car-mover bar." Its pivot-jointed end rests on the rail to transform a downward push on the 5' shank to a forward shove against a freight-car wheel. On a level siding, it lets one man move a 20-ton carload.

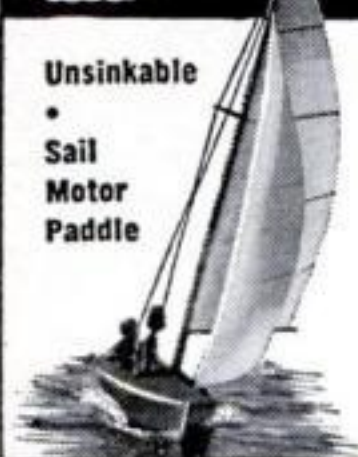
Tips on working with bars. Pick the shortest bar for hammering into joints. The inertia of larger ones absorbs much of the hammer blows' energy. Follow basic lever laws on heavy crowbar lifting jobs and keep the fulcrum close to the load. And use a fulcrum that won't crush. If you're prying against a wood surface you want to protect, place a metal pad (even a large washer) to contact the blade tip so it won't dig in. You'll get full lift, less friction, and avoid damage.

If the load can swivel as you lift it, favor a straight bar (like a crowbar); it can't flip over sideways like an angled one and offers better control. Remember, too, that prying motion is not straight. The tip of the bar blade or claw follows a circular path. As you pry upward, you will either move the pried object toward you or your blade tip will slide toward you along the contact area. Plan on this to shift heavy loads where you want them. And when the edge of your bar blade becomes blunted, use a file to dress it. A file is less likely to draw the temper by overheating the edge than a grindstone.

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PS Tests the 1896 Ford

[Continued from page 36]

ward on the control lever?" He frowned.

"You would if you could," replied Mr. De Angelis enigmatically.

I put the car in high. The throw between gears was rather long—about two feet. The engine promptly quit. Mr. De Angelis explained that it didn't have the torque for high gear. He doubted that the original Quadricycle ever achieved high, either. We got push-started again.

"No throttle?" I called, coming around.

"No, that's preset."

The instrumentation was somewhat plain. There were no dials or lights for oil pressure and engine temperature. There was no speedometer, no gas gauge, not even a radio. What I am trying to say is: there were no instruments whatsoever.

The speed, I confess, was disappointing.

"Try it going downwind," called Mr. De Angelis as I came around.

That was better. A slope helped, too.

The handling was splendid, though the steering ratio appeared rather fast. The car cornered beautifully, without lean.

"How do I stop?" I said, shifting the lever to neutral.

"Put your foot on the left front wheel," advised Mr. De Angelis.

The brake evidently had not been hooked up yet. That is in keeping with present-day practice—the dealer often has to complete what the manufacturer failed to do.

"How do I back up?" I asked.

"You don't," said Mr. De Angelis with a touch of irritation. I let the subject drop.

In sum, the Quadricycle is a sort of compact compact. The acceleration leaves something to be desired, and the top speed, let us say, is not its major virtue.

Examination of the undercarriage revealed the reason for the somewhat stiff ride. While the Quadricycle does have springs in the front, it has none at all in the rear. Also, it seemed to me that the piston travel was a bit too long for good mechanical efficiency.

On the other hand, its headroom is superb. It has no top. Nor does it have a transmission hump in the floor to fret the feet. Visibility from the driver's seat is the best I have ever seen, and there is no problem with sticky windshield wipers. There is no windshield. Engine accessibility has no peer. There's no hood. And the fuel economy is great. ■ ■

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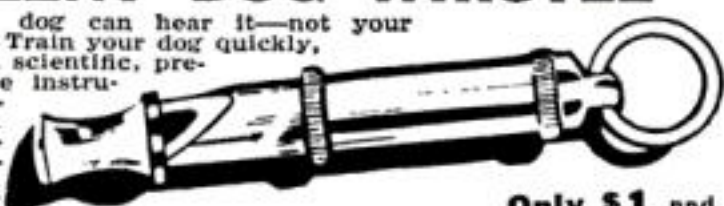
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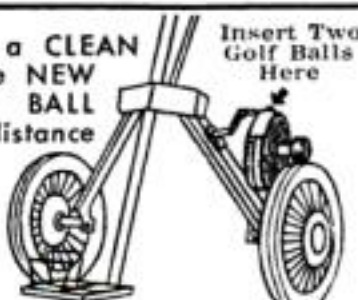
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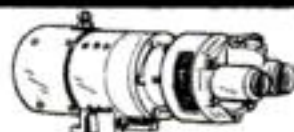


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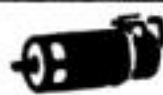
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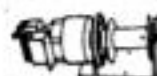
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[Continued from page 100]

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Cooling capacity. You'll need extra cooling capacity for towing. Heavy-duty radiators with thicker cores, or more fins per inch, should be ordered. (Ford, Mercury, Pontiac, Oldsmobile, Dodge, Plymouth, Chrysler, and American Motors cars offer this option.) Radiator fans with extra blades and fan shrouds to concentrate the cooling are also recommended.

Tires and wheels. Auto makers stress the importance of larger tires and heavy-duty wheels. An increase in wheel diameter allows you to use larger tires, gaining greater weight capacity and better traction. Several car makers suggest premium cords.

Suspension reinforcement. Heavy-duty front and rear springs and heavy-duty shocks (a dealer or factory-installed option) are recommended by all car makers. Overload spring devices are also available through independent suppliers to cope with the problem of rear-end sag. Beef up the suspension system. The ride doesn't suffer much—and will become more stable.

Axle ratios. Car makers recommend an increase in the numerical gear ratio for both stick and automatic shifts. If the standard ratio is 2.9:1, the buyer can order a ratio of 4:1 or more. More gear reduction results in better acceleration under load, more pulling power in the mountains, better engine braking on hills.

For trailers weighing up to 1,000 pounds, a General Motors engineer suggests a ratio of about 3.6:1; for trailers of 2,500 to 3,000 pounds, 3.9:1; for trailers above 3,000 pounds, 4.4:1.

The differential. A limited-slip differential will help keep you going in sand, mud, or snow. It prevents both rear wheels from spinning when one bogs down.

Brakes. Most manufacturers offer a "police-special" brake option—larger wheels and brake drums, more brake-lining area. This increased braking power is not necessary for trailers under 2,000 pounds, but for continuous towing it gives extra safety.

Electrical system. Heavy-duty generator or alternator, heavy-duty battery and regulator are recommended for towing duty. Lights on the trailer call for more juice. Alternators are especially recommended with trailers, since they produce steady current at low engine speeds. ■ ■

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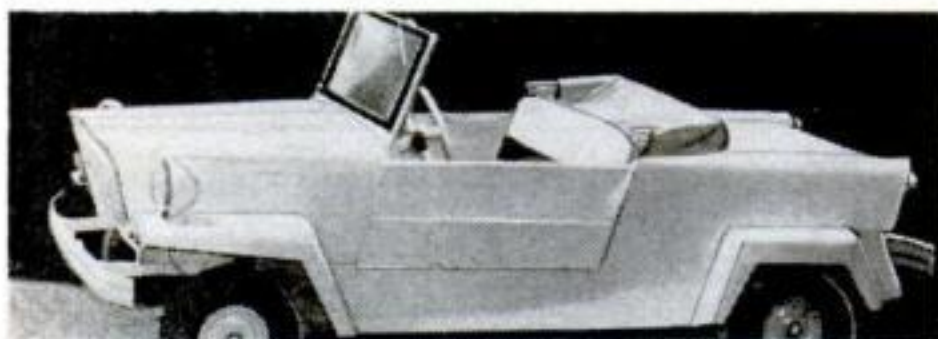
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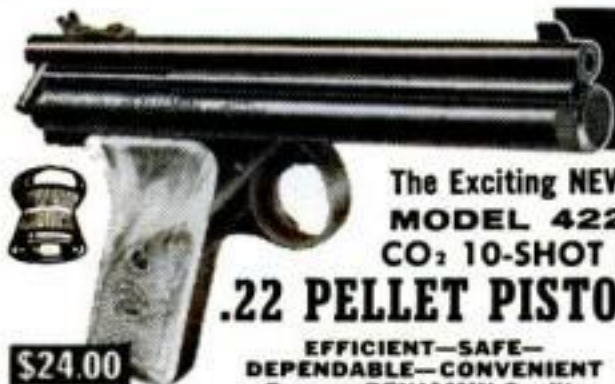


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Use Benjamin H-C Pellets in Model 422 for Accurate, Jam-Free Shooting.

BENJAMIN AIR RIFLE CO. 852 MARION ST., ST. LOUIS 4, MO.

Tape Changer: It's Here at Last

[Continued from page 94]

- Push the tape against the erase and playback/record heads.
- Pull the tape away at the end of the reel and rewind it into the cartridge.
- Lower the platform to slide the rejected cartridge under the stack on the adjacent platform in the well.
- Lower the next cartridge into playing position.

With the many cams, lever arms, spring-loaded pins, and such needed to do these jobs in sequence, jamming could be a problem. But clearing the machine needs only the turn of the sequence wheel—reached by raising the hinged lid—to the "load" position. At this point, it is ready to go again. I found it impossible to bug the machine so badly that it could not be easily corrected with the control wheel.

Tape editing is out. Reason: inaccessibility of the tape both in the cartridge and in the machine. Splicing one program to another is equally inconvenient, but the limited accessibility of the tape is played down by 3M executives who view the Revere cartridge system primarily as a playback device. You can stack cartridges for 15 hours of continuous music.

Already Columbia and Musictape are issuing prerecorded cartridges. Columbia has released about 50, Musictape about 12. Both include classics, pops, jazz, and show music. A 48-minute Columbia cartridge lists for \$9.95—against \$5.95 for a 50-minute stereo record. However, the cost of playing cartridges is considerably reduced if you make your own tapes: a cartridge of raw tape costs \$4.75 and will yield 48 minutes of sound.

The Revere stereo-tape cartridge system sells for \$450, about \$100 more than a comparable reel-to-reel four-track stereo-tape machine. What makes it worth the difference? Convenience. If you have ever had to thread a tape machine in a slightly darkened room, or cursed a reel of tape that has been spilled all over the floor, or listened to your wife's complaints that she won't play the thing because she can't work it, then the convenience may be worth the extra \$100 to you.

The 3M people are counting on buyers finding the machine so convenient that they will buy lots more tape. If 3M is right, the automatic tape changer may make tape as popular as LP records. ■ ■

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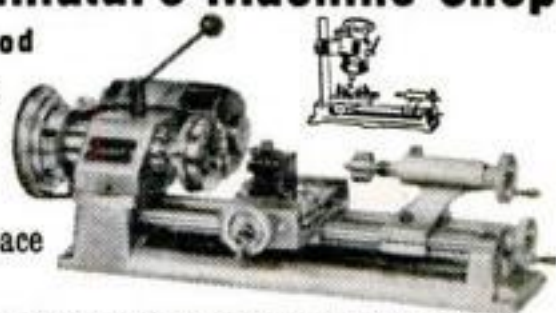
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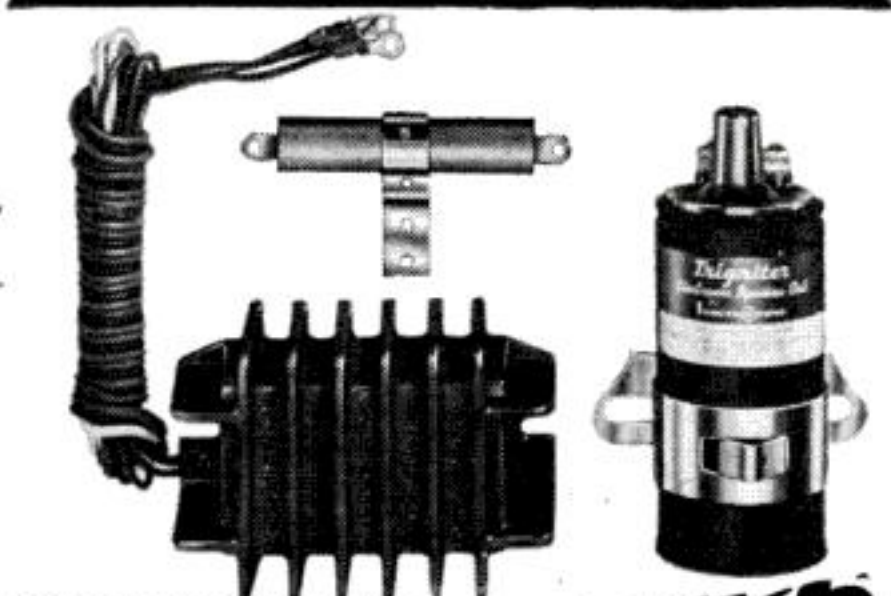
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fix it quick with

PLASTIC WOOD

Handles like putty-hardens like wood!

If Your Car Goes in the Water

[Continued from page 48]

as the vehicle rapidly filled with water.

• With windows closed, cars dropped on their sides or tops righted themselves before submerging wheels down. A car entering the water on its top with both windows open will probably remain in a wheels-up position as it submerges, and probably be found in a wheels-up position on the bottom. When cars went to the bottom on their tops, no appreciable amount of breathable air remained trapped in the floor of the passenger compartment.

What are your chances of escape?

• If your car is floating on the surface, wheels down, your best chance of escape is to roll down a window and get out through it. (In all cars tested, windows never failed to operate.) Presumably, lives are often lost when passengers panic and try in vain to open doors against water pressure. Or, finding their car afloat, they decide to stay with it until help arrives. The most critical moments are those *before the water reaches window level*. The force of water rushing through a window makes escape through the opening very difficult until the window is below the surface.

• If your car sinks too fast to permit escape while it is still on the surface, move to the rear seat to breathe the air that remains. You can escape by opening the nearest window, opening a door (when the car is below the surface), or pushing out the rear window. Rear windows are usually made of tempered glass that will disintegrate if pierced with a pointed object or struck with any hammerlike object.

What about rescue methods?

• If you see a vehicle floating on the surface with all windows closed, shout or signal to the passengers to open the windows. If they can't, you'll have to break a window to get them out. The rear window is best; you can pierce its tempered glass. Side windows, depending on the car's age, may be safety glass—hard to break.

• If the doors aren't sprung, they open easily once the car slips below the surface.

• When rescuing a person from a station wagon, try to open the tailgate. Tests indicated that persons trapped in a station wagon would probably have a better chance to escape if the tailgate could be opened from the inside. ■ ■

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New rugged design retriever assembly. Strong handle. Alnico V permanent magnet. Pulls 125 Lb. on steel block. More in water. No. R125 (5"x3 1/2"/wt. 5 lbs.) . . . \$7.95 ppd.
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Easily adapts to any machine where it is necessary to count up to five digits. 45° arm actuates register . . . arm may be set in any position and spring will

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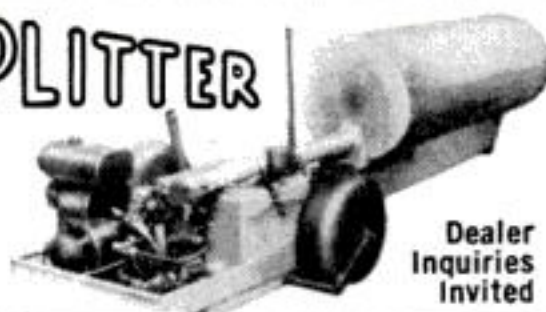
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LARGEST OIL LEASE AGENTS IN FEDERAL LAND



New Epoxy Coating for Shower Walls

[Continued from page 139]

taking down old plastic tile, wire-brush away the adhesive residue. If the wall was painted, make certain there are no chips, cracks, or peeling strips, and scrub down the surface. It's also wise to try an inconspicuous test patch over old paint. Epoxy coatings may not adhere properly to some poorer-quality paints.

Temperatures. Apply and allow the coating to dry at normal room temperature (about 70 to 75 degrees). If the room is much colder than 60 degrees, the coating practically stops drying, and if it's above 80, it will set up too fast.

Present cost is about \$5 a quart, enough to cover roughly 100 square feet. There are three or four companies presently marketing it, and others are preparing to enter the field, so it's likely the price will come down some.

Manufacturers say the coating has an expected life of about 15 to 20 years. Then it begins to alligator. In two or three years, the light colors start to darken, and the white and ivory shades may yellow some. This is standard for pigments and the change is uniform, so it's doubtful you'll even notice it.

In addition to making a glass-smooth surface, the coating has another very usable quality—remarkable adhesion. For example, in addition to coating the wall around a tub, it will flow on and adhere to the porcelain surface of the tub—or any other fixture in the house. It will also stick tenaciously to metal, ceramic, fiberglass, or masonry materials, inside or outside the house. Preparation of the surface is different in each case, but manufacturers' instructions are clear enough. Follow them.

Epoxy coatings aren't brand new, but this is the first type for home use. For over five years, boat owners have been applying it (in slightly different form) to any paintable surface on their craft. The coating has also gotten a good workout in industrial applications.

If you want to impress your friends, the two major chemicals in the base resin are epichlorohydrin and phenol. Now all you need do is pronounce them. Three firms now producing the epoxy coating for the home are: Klenk Epoxy Corp., Detroit; Wilbur & Williams Co., Inc., Norwood, Mass.; and Sapolin Paints, Inc., 205 E. 42 St., NYC.
—John H. Ingersoll.

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JEEP Owners—V8 conversions. Read Jeep Owners ad, page 185.

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USE THIS HANDY INDEX TO FIND WHAT YOU WANT

Advertising, Agencies for Advertisers . . .	53
Agents Wanted . . .	43
Antiques, Relics & Indian Goods . . .	29
Art Instruction, Cartooning, Sign Painting . . .	54
Artists Supplies . . .	76
Astronautics . . .	5A
Authors Service . . .	52
Auto Supplies & Equipment . . .	2
Auto Trailers . . .	3
Automobiles & Midget Cars . . .	1
Aviation . . .	5
Boats, Outboard Motors . . .	11
Body-Building Courses, Jiu Jitsu, Etc. . .	12
Books & Magazines . . .	23
Business Opportunities . . .	37
Business Service, Information, Name Lists . . .	50
Buy It Wholesale . . .	38A
Cameras, Photo Supplies . . .	34
Camping Equipment & Tents . . .	16
Coins & Currency . . .	26
Detectives . . .	47
Do-It-Yourself . . .	66
Dogs, Birds, Hamsters & Pets . . .	17
Earthworms, Crickets, Frogs . . .	18
Educational & Instruction . . .	45
Electrical Supplies & Equipment . . .	7
Employment Information . . .	42
Engines, Motors, Etc. . .	10
Farms, Other Real Estate . . .	19
Field Glasses, Telescopes . . .	14
For Inventors . . .	60
For Sale Miscellaneous . . .	71
Formulas, Plans, Etc. . .	39
Government Surplus . . .	11A
High-Grade Salesmen . . .	44
Hobbies, Collections . . .	31
Home Craftsman . . .	65
Hypnotism . . .	24
Import-Export . . .	38B
Inventions Wanted . . .	61
Language Outfits . . .	48
Loans By Mail . . .	80B
Machinery, Tool Supplies, Etc. . .	9
Magic Tricks, Puzzles, Etc. . .	25
Minerals & Precious Stones . . .	30
Miscellaneous . . .	79
Models, Model Supplies . . .	64
Moneymaking Opportunities . . .	38
Motion Pictures & Color Slides . . .	33
Motorcycles, Bicycles & Supplies . . .	4
Musical Instruments and Song Writers . . .	35
Of Interest To Women . . .	70
Old Gold, Jewelry, Watches . . .	67
Personal . . .	80
Phonograph Records . . .	35A
Photo Finishing, Photocopies, Etc. . .	32
Plastics . . .	40
Printing, Multigraphing, Etc. . .	57
Printing Outfits, Supplies . . .	58
Profitable Occupations . . .	22
Radio, TV, Electronics, Hi-Fi . . .	36
Remailing Service . . .	80A
Rubber Stamps & Office Supplies . . .	56
Science & Chemistry . . .	41
Special Services . . .	51
Sporting Goods, Guns, Fishing Tackle, Etc. . .	15
Stamp Collecting . . .	28
Tattooing Supplies . . .	75
Tobacco & Pipes . . .	68
Treasure Finders & Geiger Counters . . .	77
Trees, Shrubs, Roots & Herbs . . .	20
Typewriters & Office Machines . . .	55
Wanted to Buy . . .	72
Watch Repairing . . .	78
Welding, Soldering . . .	8

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- ☐ College Preparatory

MECHANICAL and SHOP

- ☐ Gas and Electric Welding
- ☐ Industrial Engineering
- ☐ Industrial Instrumentation
- ☐ Machine Design
- ☐ Machine Shop Practice
- ☐ Mechanical Engineering
- ☐ Reading Shop Blueprints
- ☐ Tool Design
- ☐ Toolmaking
- ☐ Safety Engineering

SECRETARIAL

- ☐ Clerk-Typist
- ☐ Professional Secretary

- ☐ Shorthand
- ☐ Stenographic
- ☐ Typist

STEAM and DIESEL POWER

- ☐ Boiler Inspector
- ☐ Power Plant Engineering
- ☐ Stationary Diesel Engineering
- ☐ Steam Engineering

SUPERVISION

- ☐ Foremanship—Suprv'n
- ☐ Personnel—Lab. Rel'ns

TV-RADIO

- ☐ Radio and TV Servicing
- ☐ Radio-Telephone License
- ☐ TV Technician
- ☐ Practical Radio-TV Engineering

MISCELLANEOUS

- ☐ Railroad
- ☐ Textile
- ☐ Other (please specify)

Name _____ Age _____ Sex _____
Home Address _____
City _____ Zone _____ State _____
Occupation _____
Employed by _____ Working Hours _____ Special low rates to members of U. S. Armed Forces!

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Each morning you can apply last night's assignment to the job at hand. Many I.C.S. students get raises in pay even before they finish their I.C.S. courses!

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And you are on your way—just because you decided to mail this coupon—with absolutely no obligation to you. Don't hold back. Mail your coupon today, and see how fast things happen for you!



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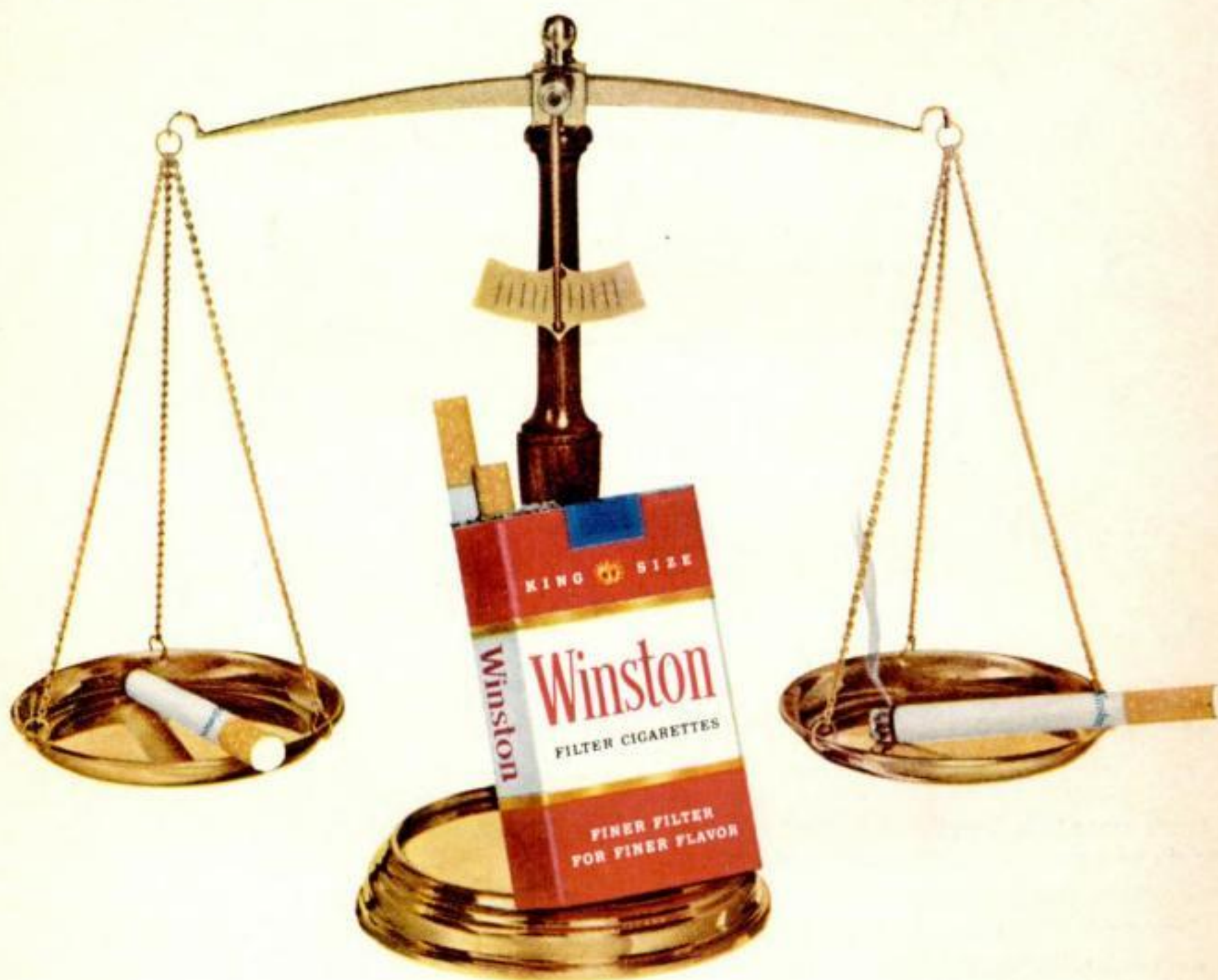
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